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ROC800-Series Remote Operations Controller Instruction Manual

ROC809

ROC827

Remote Automation Solutions

EMERSON
Process Management

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Chapter 1 – General Information

This manual focuses on the hardware aspects of the ROC809 and ROC827 Remote Operations Controllers – also known as the ROC800-Series controllers ("ROC800") – and the ROC800-Series expansion backplanes ("EXPs"), that attach **only** to the ROC827 and provide increased I/O capabilities.

For technical information on the ROC800s, refer to the technical specifications *ROC800:800*, and *ROC800:FW1* (available at *www.EmersonProcess.com/Remote*). For information about the software you use to configure the ROC800-Series, refer to the *ROCLINK™ 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012).

ROC800L

This manual also discusses the hardware for the ROC800L, a ROC800-Series device that is factory-loaded with specific firmware and software designed to measure and manage the flow of liquid hydrocarbons.

For technical information on the ROC800L, refer to the technical specifications *ROC800:800L*, and *ROC800:SW1*. For information about the software you use to configure the ROC800L, refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

ROC800 or ROC800L?

The ROC800-Series are principally designed to measure the flow of natural gas in accordance with AGA and other standards. Firmware and user programs enhance that functionality.

To meet market demands, Remote Automation Solutions initially developed user programs to perform flow calculations for certain liquids. These programs grew to encompass flow and volume corrections for most liquid hydrocarbons (as defined by the API in the Manual for Petroleum Measurement Systems, or MPMS). Finally, to modularize these capabilities and ensure the integrity of the AGA calculations, we developed a suite of user programs enabled by a license key.

This chapter details the structure of this manual and provides an overview of the ROC800 and its components.

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The ROC800 is a microprocessor-based controller that provides the functions required for a variety of field automation applications. It is ideal for applications requiring general logic and sequencing control; historical data archiving; multiple communication ports; Proportional, Integral, and Derivative (PID) control; and flow measurement on up to twelve meter runs.

1.1 Scope of Manual

This manual contains the following chapters:

Chapter 1 General Information	Provides an overview of the hardware and specifications for the ROC800 and the ROC800-Series expansion backplanes (EXPs).
Chapter 2 Installation and Use	Provides information on installation, tools, wiring, mounting the ROC800, and other essential elements of the ROC800 and EXPs.
Chapter 3 Power Connections	Provides information on the Power Input modules available for the ROC800 base unit and provides worksheets to help determine power requirements for the ROC800 configurations.
Chapter 4 Input/Output (I/O) Modules	Provides information for the Input/Output (I/O) modules available for the ROC800 and EXPs.
Chapter 5 Communications	Provides information for the built-in communication capabilities and the optional communication modules available for the ROC800.
Chapter 6 Troubleshooting	Provides information on diagnosing and correcting problems with the ROC800.
Chapter 7 Calibration	Provides information for calibrating Analog Inputs, HART® Inputs, RTD Inputs, and MVS Inputs for the ROC800.
Glossary	Provides generalized definitions of acronyms and terms.
Wiring Diagrams	Provides diagrams that show how to wire the modules to various industry-standard devices.
Index	Provides an alphabetic listing of items and topics contained in this manual.

1.2 Series 1 versus Series 2 Architecture

The Series 2 ROC800 architecture incorporates a redesigned CPU module and redesigned expansion I/O backplanes to provide major system advancements. These include an increase in processor speed (from 50MHz to 65MHz), an increase in SRAM for User C programs (20K to 100K), an increase in flash memory (4Mb to 16Mb), an increase in DRAM (8Mb to 16Mb), and greater general flexibility in module placement. For easy visual identification, the printed circuit board (PCB) for the Series 2 CPU module, the PCB for the Series 2 base unit and expansion backplanes, and the Series 2 ROC800 ABS plastic housing are all black. Additionally, the Series 2 CPU module is labeled **CPU Series 2** (see *Figure 1-1*).

Note: In the Series 1 ROC800, the PCBs for the CPU module, the base unit, and the backplanes are green; the ABS plastic housing is gray.

What's Compatible?

In the Series 2 ROC827, you **cannot** insert a Series 1 CPU module into a Series 2 base unit or attach Series 1 expansion backplanes to Series 2 base units or expansion backplanes. Firmware is not available to upgrade a Series 1 CPU module to the new functionally. To obtain the Series 2 enhancements, you must obtain and use a Series 2 CPU module.

The architecture of the ROC809's fixed backplane allows you to insert a black Series 2 CPU module into a Series 1 (green) backplane. However, firmware is not available to upgrade a Series 1 CPU module to the new functionality. To obtain the Series 2 enhancements, you must obtain and use a Series 2 CPU module.

Note: The ROC800L functions **only** on the Series 2 hardware platform.

Module Placement

Table 1-1 compares module placement in the ROC809, based on the installation of a Series 1 or Series 2 CPU. *Table 1-2* compares module placement in the ROC827, based on the installation of a Series 1 or Series 2 CPU.

Table 1-1. ROC809 Module Placement (Series 1 CPU vs. Series 2 CPU)

Module	ROC809 Series 1 CPU	ROC809 Series 2 CPU	Module Color
AI-12	Any	Any	Grey
AI-16	Any[1]	Any	Black
AO	Any	Any	Grey
APM	Any[2]	Any	Grey
RS-485	1st three slots	1st three slots	Grey
RS-232	1st three slots	1st three slots	Grey
Dial-up Modem	1st three slots	1st three slots	Grey
MVS[3]	1st three slots	1st three slots	Grey
MVS I/O[3]	1st three slots	Any	Black

Module	ROC809 Series 1 CPU	ROC809 Series 2 CPU	Module Color
DI	Any	Any	Grey
HART	Any	Any	Grey
HART-2	None	Any[4]	Black
DO	Any	Any	Grey
DOR	Any	Any	Grey
RTD	Any	Any	Grey
TC	Any	None	Grey
TC2	None	Any[5]	Black
PI	Any	Any	Grey
IEC 62591	None	Any	Black
NRM	None	1st three slots	Black
AC I/O	Any	Any	Grey
APP485	Any	Any	Black

[1] With firmware version 2.13 or greater
[2] With firmware version 2.10 or greater
[3] The ROC809 supports a maximum of two MVS modules
[4] With firmware version 3.10 or greater
[5] With firmware version 3.20 or greater

Table 1-2. ROC827 Module Placement (Series 1 CPU vs. Series 2 CPU)

Module	ROC827 Series 1 CPU	ROC827 Series 2 CPU	Module Color
AI-12	Any	Any	Grey
AI-16	Any	Any	Black
AO	Any	Any	Grey
APM	1st three slots[2]	Any	Grey
RS-485	1st three slots	1st three slots	Grey
RS-232	1st three slots	1st three slots	Grey
Dial-up Modem	1st three slots	1st three slots	Grey
MVS[3]	1st three slots	1st three slots	Grey
MVS I/O[3]	1st three slots	Any	Black
DI	Any	Any	Grey
HART	1st three slots	Any	Black
HART-2	None	Any	Black
DO	Any	Any[4]	Grey
DOR	Any	Any	Grey
RTD	Any	Any	Grey
TC	Any	None	Grey
TC2	None	Any[5]	Black
PI	Any	Any	Grey
IEC 62591	None	Any	Black
NRM	None	1st three slots	Black
AC I/O	1st three slots	Any	Grey
APP485	Any	Any	Black

[1] With firmware version 2.13 or greater
[2] With firmware version 2.10 or greater
[3] The ROC827 supports a maximum of two MVS modules
[4] With firmware version 3.10 or greater
[5] With firmware version 3.20 or greater

Note: For further information, refer to the technical specification *ROC800*. For further information on compatibility and migration issues, refer to the *Remote Automation Solutions Technical Support White Paper WP0800004R1*.

1.3 Hardware

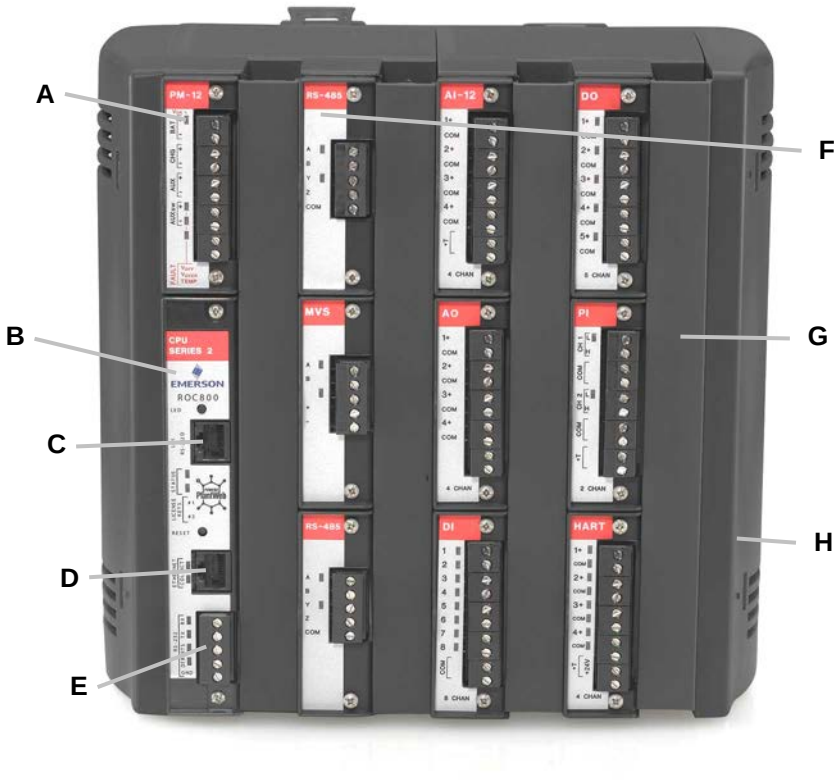
The ROC809 and ROC827 are highly innovative and versatile units with an integrated backplane to which the central processor unit (CPU), power input module, communication modules, and I/O modules connect. The ROC809 (see *Figure 1-1*) has nine module slots, of which three can house communication modules. The ROC827 base unit (shown on the left-hand side of *Figure 1-2*) has three I/O module slots.

The ROC800-Series expansion backplanes (EXPs) attach to the ROC827 base unit (see *Figure 1-2*). Each EXP provides six additional I/O module slots. The ROC827 can support up to four EXPs, for a total of 27 I/O module slots (six slots per EXP plus the three I/O slots on the ROC827 base unit).

The ROC800s use a Power Input module to convert external input power to the voltage levels required by the electronics and to monitor voltage levels to ensure proper operation. Three Power Input modules—12 Volts dc (PM-12), 24 Volts dc (PM-24), and 30 Volts dc (PM-30)—are available. For more information on the Power Input modules, refer to *Chapter 3, Power Connections*.

The ROC800s support a variety of communication protocols: ROC Plus, Modbus, Modbus TCP/IP, Modbus encapsulated in TCP/IP, and Modbus with Electronic Flow Measurement (EFM) extensions.

Figure 1-1 shows the housing, typical I/O modules, and communication modules installed in a ROC809. The patented ABS (Acrylonitrile Butadiene Styrene) plastic housing has wire covers to protect the wiring terminals. The housing includes DIN rail mounts for mounting the unit on a panel or in a user-supplied enclosure. Patent 6,771,513 covers the ROC800 enclosure (refer to *www.uspto.gov*).



A Power Supply Module
B CPU
C LOI (Local Port) EIA-232 (RS-232D)
D Built-in Ethernet (Comm1)
E Built-in EIA-232 (RS-232C) (Comm2)
F Module (1 of 9 max)
G Wire Channel Cover
H Right End Cap

Figure 1-1. ROC809

Module Placement

The left-most slots in the ROC809 (*Figure 1-1*) accommodate the Power Input module and the CPU module. The remaining nine slots can accommodate either communication modules or I/O modules (see *Table 1-1*).

Note: If you use the optional communications modules, you can **only** place those modules in the three slots (**1**, **2**, or **3**) immediately to the right of the Power Input and CPU modules. Place I/O modules in **any** available slot.

Figure 1-2 shows a ROC827 base unit (left) and a typical expansion backplane (EXP) (right) populated with a full complement of six I/O modules. Each EXP is composed of the same plastic housing as the ROC827, contains six I/O slots, and has a powered backplane that easily attaches to the ROC827 and other EXPs.

A Power Supply Module
B CPU
C LOI (Local Port) EIA-232 (RS-232D)
D Built-in Ethernet (Comm1)
E Built-in EIA-232 (RS-232C) (Comm2)
F Module (1 of 27 max)
G Wire Channel Cover
H Right End Cap

Figure 1-2. ROC827 Base Unit with One Expansion Backplane (separated for clarity)

I/O Modules

The ROC800 and EXPs support various types of Input/Output (I/O) modules, which can satisfy a wide variety of field I/O requirements (refer to *Chapter 4, Input/Output Modules*). You can place I/O modules in any available slot. I/O modules include:

- Analog Inputs (AI).
- Analog Outputs (AO).
- Discrete Inputs (DI).
- Discrete Outputs (DO).
- Digital Relay Outputs (DOR).
- Advance Pulse Module (APM).
- Alternating Current I/O (ACIO).
- Multi-variable Sensor (MVS I/O).
- Highway Addressable Remote Transducer (HART®) Module.
- Pulse Inputs (PI) – High/Low Speed.
- Resistance Temperature Detector Inputs (RTD).
- Thermocouple (TC) Inputs.
- IEC 62591.
- APP 485.

Communication Ports and Modules

The ROC800 provides up to six communication ports (refer to *Chapter 5, Communications*). Three communication ports are built-in:

- **Local Operator Interface (LOI)** – Local Port EIA-232 (RS-232D).
- **Ethernet** – Comm1 Port for use with the DS800 Development Suite Software.
- **EIA-232 (RS-232C)** – Comm2 Port for point-to-point asynchronous serial communications.

Communication modules (which you install **only** in slots 1 [Comm3], 2 [Comm4], or 3 [Comm5] in the ROC800) provide additional ports for communicating with a host computer or other devices. Modules include:

- **EIA-232 (RS-232C)** – Point-to-point asynchronous serial communications include Data Terminal Ready (DTR) support, Ready To Send (RTS) support, and radio power control.
- **EIA-422/EIA-485 (RS-422/RS-485)** – Point-to-point (EIA-422) or multiple-point (EIA-485) asynchronous serial communications.
- **Multi-Variable Sensor (MVS)** – Interfaces with MVS Sensors (up to two modules per ROC800).
- **Dial-up modem** – Communications over a telephone network (14.4K V.42 bis with throughput up to 57.6K bps).
- **NRM** – Network Radio Module

⚠ Caution

The design of ROC800-Series communications and I/O modules supports "hot-swapping" (replacing similar modules in the same slot) and "hot-plugging" (inserting modules into an empty slot) while the ROC800 is powered. However, it is a good safety practice with any electrical device to first remove power before you make internal connections. If you find it necessary to hot-swap or hot-plug a module, first review the most current specification sheet for that module to ensure both your safety and the integrity of data that module may provide.

FOUNDATION™ Fieldbus Interface

The FOUNDATION Fieldbus Interface (FFI) is a ROC800-based solution that enables a ROC800 to support bi-directional multi-drop digital communications between fieldbus devices.

While you can implement the FFI as a stand-alone device, you can also install it as an integral part of the ROC827 housing, since the FFI is based on a standard Series 2 EXP. However, the FFI does not expand the I/O capability of the ROC827 beyond the 27 module-limit.

For technical information on the FFI, refer to the technical specifications *ROC800:FFI* or the *FOUNDATION Fieldbus Interface Instruction Manual* (Part Number D301461X012). For information about the software you use to configure the FFI, refer to the *Field Interface Configurator User Manual* (Part Number D301575X012).

1.3.1 Central Processor Unit (CPU)

The CPU contains the microprocessor, the firmware, connectors to the backplane, the three built-in communication ports (two with LEDs), a LED low power wakeup button, a RESET button, the application license key connectors, a STATUS LED indicating system integrity, and the main processor.

CPU components include:

- 32-bit Motorola MPC862 Quad Integrated Communications Controller (PowerQUICC) PowerPC processor. Bus clock frequency at 65 MHz with a watchdog timer.
- Flash ROM (Read-Only Memory).
- SDRAM (Synchronous Dynamic Random Access Memory).
- Diagnostic monitoring.
- Real-Time Clock.
- Automatic self-tests.
- Power saving modes.
- Local Operator Interface (LOI) EIA-232 (RS-232D) Local Port.
- EIA-232 (RS-232C) serial Comm2 port.
- Ethernet Comm1 port.

1.3.2 Real-Time Clock (RTC)

You can set the ROC800's real-time clock (RTC) for year, month, day, hour, minute, and second. The clock provides time stamping of the database values. The battery-backed clock firmware tracks the day of the week and corrects for leap year. The time chip automatically switches to backup power when the ROC800 loses primary input power.

The internal Sanyo 3-volt CR2430 lithium battery provides backup for the data and the RTC when the main power is not connected. The battery has a one-year minimum backup life with the battery installed, the jumper disengaged, and no power applied to the ROC800. The battery has a ten-year backup life with the backup battery installed and power applied to the ROC800 or when the battery is removed from the ROC800.

Note: If the real-time clock does not keep the current time when you remove power, replace the lithium battery.

1.3.3 Diagnostic Monitoring

The ROC800 has diagnostic inputs incorporated into the circuitry for monitoring system integrity. Use ROCLINK 800 software to access the System Analog Inputs (on the directory tree, double-click **I/O**, **System Analog Input**, and **#1, Battery** to open the System Analog Input screen). Refer to *Table 1-3*.

Table 1-3. System Analog Inputs

System AI Point Number	PM-12 Function	PM-24 Function	PM-30 Function
1	Battery Input Voltage	Module Voltage	Module Voltage
2	Charge in Voltage	Module Voltage	Voltage In
3	Module Voltage	Module Voltage	Module Voltage
4	Not Used	Not Used	Not Used
5	On Board Temperature	On Board Temperature	On Board Temperature

Note: The PM-24 module's DC-to-DC converter supplies approximately 12 volts to the backplane, which is reflected in the on-screen values for points 1 through 3.

1.3.4 Options

The ROC800 allows you to choose from a wide variety of options to suit many applications.

Optional communication modules include EIA-232 (RS-232) serial communications, EIA-422/485 (RS-422/485) serial communications, Multi-Variable Sensor (MVS), dial-up modem communications, and the HART module (refer to *Chapter 5, Communications*).

The ROC800 can handle up to two MVS interface modules. Each module can provide power and communications for up to six MVS sensors, for a total of up to 12 MVS sensors per ROC800 (refer to *Chapter 5, Communications*).

Optional I/O modules include Analog Inputs (AI), Analog Outputs (AO), Discrete Inputs (DI), Discrete Outputs (DO), Discrete Output Relays (DOR), Pulse Inputs (PI), Resistance Temperature Detector (RTD) Inputs, Thermocouple (T/C) Inputs, Advanced Pulse (APM), and Alternating Current I/O (ACIO) (refer to *Chapter 4, Input/Output Modules*).

The optional application license keys provide extended functionality, such as the use of the DS800 Development Suite Software (the IEC 61131-3 compliant programming environment) and various user programs, and enable embedded meter runs. For example, you need to install a license key with the proper license in the ROC800 to perform AGA calculations. Refer to *Section 1.6, DS800 Development Suite Software*.

The Local Operator Interface (LOI local port) communications terminal requires the installation of an LOI cable between the ROC800 and your PC. The LOI port uses an RJ-45 connector with a standard EIA-232 (RS-232D) pin out.

1.4 FCC Information

This equipment complies with Part 68 of the FCC rules. Etched on the modem assembly is, among other information, the FCC certification number and Ringer Equivalence Number (REN) for this equipment. If requested, this information must be provided to the telephone company.

This module has an FCC-compliant telephone modular plug. The module is designed to be connected to the telephone network or premises' wiring using a compatible modular jack that is Part 68-compliant.

The REN is used to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. Typically, the sum of the RENs should not exceed five (5.0). Contact the local telephone company to determine the total number of devices that may be connected to a line (as determined by the total RENs).

If this equipment and its dial-up modem causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. However, if advance notice is not practical, the telephone company will notify the customer as soon as possible. In addition, you will be advised of your right to file a complaint with the FCC if you believe it necessary.

The telephone company may make changes to its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice so you can make the necessary modifications to maintain uninterrupted service.

If you experience trouble with this equipment or the dial-up modem, contact Emerson Process Management's Remote Automation Solutions (at 1-800-537-9313) for repair or warranty information. If the equipment harms the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

1.5 Firmware

The firmware that resides in Flash Read-Only Memory (ROM) contains the operating system, ROC Plus communications protocol, and application software. The CPU module provides battery-backed Static Random Access Memory (SRAM) for saving configurations, storing events, alarms, and the historical logs.

ROC800 or ROC800L

The ROC800-Series supports either of two sets of firmware. The original ROC800 firmware is designed primarily to support gas flow measurements. The ROC800L firmware is designed to support both liquids and gas flow measurements.

Note: To convert a ROC800 to a ROC800L, refer to the *ROC800L Field Conversion Guide* (Part Number D301683X012).

The ROC800-Series Operating System firmware provides a complete operating system for the ROC800. The firmware in the ROC800 is field-upgradeable using a serial connection or the Local Operator Interface (LOI) local port. For more information, refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012)

The firmware supports:

- Input/Output Database.
- Historical Database.
- Event and Alarm Log Databases.
- Applications (PID, AGA, FST, and such).
- Measurement Station Support.
- Determining Task Execution.
- Real-Time Clock.
- Establishing and Managing Communications.
- Self-Test Capability.

The firmware makes extensive use of configuration parameters, which you configure using ROCLINK 800 software.

RTOS The ROC800-Series firmware uses a pre-emptive, multi-tasking, message-based Real-Time Operating System (RTOS) with hardware-supported memory protection. Tasks are assigned priorities and, at any given time, the operating system determines which task will run. For instance, if a lower priority task is executing and a higher priority task needs to run, the operating system suspends the lower priority task, allows the higher priority task to run to completion, then resumes the lower priority task's execution. This is more efficient than a "time sliced" architecture type.

TLP The ROC800 reads data from and writes data to data structures called "points." A "point" is a ROC Plus Protocol term for a grouping of individual parameters (such as information about an I/O channel) or some other function (such as a flow calculation). Points are defined by a collection of parameters and have a numerical designation that defines the type of point (for example, point type 101 refers to a Discrete Input and point type 103 refers to an Analog Input).

The logical number indicates the physical location for the I/O or the logical instance for non-I/O points within the ROC800. Parameters are individual pieces of data that relate to the point type. For instance, the raw A/D value and the low scaling value are parameters associated with the Analog Input point type, 103. The point type attributes define the

database point to be one of the possible types of points available to the system.

Together, these three components—the type (T), the logical (L), and the parameters (P)—can be used to identify specific pieces of data that reside in a ROC800's data base. Collectively, this three-component address is often called a "TLP."

I/O Database The Input/Output database contains the input and output points the operating system firmware supports, including the System Analog Inputs, Multi-Variable Sensor (MVS) inputs, and Input/Output (I/O) modules. The firmware automatically determines the point type and point number location of each installed I/O module. It then assigns each input and output to a point in the database and includes user-defined configuration parameters for assigning values, statuses, or identifiers. The firmware scans each input, placing the values into the respective database point. These values are available for display and historical archiving.

SRBX Spontaneous-Report-by-Exception (SRBX or RBX) communication allows the ROC800 to monitor for alarm conditions and, upon detecting an alarm, automatically reports the alarm to a host computer. Any kind of communications link—dial-up modem or serial line—can perform SRBX as long as the host is set up to receive field-initiated calls.

Protocols The firmware supports both the ROC Plus protocol and the Modbus master and slave protocol. ROC Plus protocol can support serial communications and radio or telephone modem communications to local or remote devices, such as a host computer.

The firmware also supports the ROC Plus protocol over TCP/IP on the Ethernet port. The ROC Plus protocol is similar to the ROC 300/400/500 protocol, since it used many of the same opcodes.

For more specific information refer to the *ROC Plus Protocol Specifications Manual* (Part Number D301180X012) or the *ROC800L Protocol Specifications Manual* (Part Number D301659X012), or contact your local sales representative.

The ROC800-Series firmware also supports Modbus protocol as either master or slave device using Remote Terminal Unit (RTU) or American Standard Code for Information Interchange (ASCII) modes. This allows you to easily integrate the ROC800 into other systems. Extensions to the Modbus protocol allow the retrieval of history, event, and alarm data in Electronic Flow Metering (EFM) Measurement applications.

Note: In Ethernet mode, the firmware supports Modbus both in master and slave mode.

Security The ROCLINK 800 software also secures access to the ROC800. You can define and store a maximum of 16 case-sensitive user identifiers (User IDs). In order for the ROC800 to communicate, a case sensitive

log-on ID supplied to the ROCLINK 800 software must match one of the IDs stored in the ROC800.

The operating system firmware supports the application-specific firmware supplied in the Flash ROM. The application firmware includes Proportional, Integral, and Derivative (PID) Control; FSTs; Spontaneous-Report-By-Exception (SRBX) Communications Enhancement; optional American Gas Association (AGA) Flow calculations with station support; and optional IEC 61131-3 language programs (using DS800 Development Suite software). Applications reside in the firmware, so you do not need to re-build and download the firmware for changes in calculation method.

Input Module Addressing

The Series 1 ROC800 defaults to 16-point addressing, but automatically switches to 8-point addressing if you add a fourth or fifth expansion backplane.

The Series 2 ROC800 defaults to 8-point addressing. To switch to 16-point addressing, you must manually select this option.

Note: To change input module addressing, select **ROC** > **Device Information** in ROCLINK 800. On the Device Information screen's General tab, select either **8-Points Per Module** or **16-Points Per Module** in the Logical Compatibility Mode frame and click **Apply**.

The difference between 16-point and 8-point addressing becomes critical when you have a host device reading data from specific TLPs. For example, under 16-point addressing, channel 2 for a DI module in slot 2 is referenced by TLP 101,33,3. Under 8-point addressing, channel 2 for a DI module in slot 2 is referenced by TLP 101,17,23. *Table 1-4* illustrates the difference between 8-point and 16-point addressing.

Table 1-4. 16-Point vs. 8-Point Addressing

Slot Number	Logicals (16 pt)	Logicals (8 pt)
0	0–15	0–7
1	16–31	8–15
2	32–47	16–23
3	48–63	24–31
4	64–79	32–39
5	80–95	40–47
6	96–111	48–55
7	112–127	56–63
8	128–143	64–71
9	144–159	72–79
10	N/A	80–87
11	N/A	88–95
12	N/A	96–103
13	N/A	104–111
14	N/A	112–119
15	N/A	120–127
16	N/A	128–135
17	N/A	136–143

Slot Number	Logicals (16 pt)	Logicals (8 pt)
18	N/A	144–151
19	N/A	152–159
20	N/A	160–167
21	N/A	168–175
22	N/A	176–183
23	N/A	184–191
24	N/A	192–199
25	N/A	200–207
26	N/A	208–215
27	N/A	216–223

ROC800L The ROC800L firmware provides many of the same capabilities as the ROC800 firmware. We recommend, however, that the ROC800L supports only six gas runs (using a single AGA key). History stored in firmware is limited to measurements from gas meter runs, rather than liquids. Software supports most liquid-related capabilities; other firmware functions remain the same.

1.5.1 Historical Database and Event & Alarm Log

The historical database provides archiving of measured and calculated values for either on-demand viewing or saving to a file. It provides an historical record in accordance with API Chapter 21.1. You can configure each of up to 240 points in the historical database to archive values under various schemes, such as averaging or accumulating, as appropriate for the type of database point.

The historical database is maintained in 13 segments (0-12). You can configure each segment in the database to archive selected points at specified time intervals. The segments can continuously archive or can be turned on and off.

Note: Configure gas meter history in segments 1-12, where a segment number corresponds to a station number (meter history for station 1 in segment 1, and so on). This allows configuration changes to trigger archive records in accordance with API 2.1 guidelines.

You can distribute history points among history segments 1 through 12 and the general history segment. For each history segment, you can configure the number of periodic history values archived, the frequency of archiving periodic values, the number of daily values archived, and the contract hour. The number of minute values is fixed at 60. The 240 points provide a total of over 224,000 entries (equal to more than 35 days of 24-hour data for 240 points).

The Event Log records the last 450 parameter changes, power on and off cycles, calibration information, and other system events. The event is recorded along with a date and time stamp. The Alarm Log records the last 450 configured occurrences of alarms (set and clear). You can

view the logs, save them to a disk file, or print them using ROCLINK 800 software.

ROC800L To accommodate NIST Handbook 44 (HB 44) requirements, the firmware in the ROC800L tracks up to 1000 weights and measures (W&M) events.

1.5.2 Meter Runs and Stations

You can group similarly configured meter runs into stations, which provide great benefits during configuration and reporting. You can also configure each meter run, which eliminates redundant meter run data within a station and enables faster data processing.

You can group meter runs among the maximum of twelve stations in any combination. Meter runs belong in the same station when they have the same gas composition data and calculation methods. Stations allow you to:

- Set contract hours differently for each station.
- Designate several individual meter runs as part of a station.
- Configure one to twelve meter runs for each station.

Note: For the ROC800L, you configure runs and stations using the individual user programs.

1.5.3 ROC800 Flow Calculations

For the ROC800, gas and liquid calculation methods include:

- AGA and API Chapter 21 compliant for AGA linear and differential meter types.
- AGA 3 – Orifice Plates for gas.
- AGA 7 – Turbine Meters (ISO 9951) for gas.
- AGA 8 – Compressibility for Detailed (ISO 12213-2), Gross I (ISO 12213-3), and Gross II for gas.
- ISO 5167 – Orifice Plates for liquid.
- API 12 – Turbine Meters for liquid.

ROC800 firmware completes full calculations every second on all configured runs (up to 12) for AGA 3, AGA 7, AGA 8, ISO 5167, and ISO 9951.

AGA 3 calculations conform to the methods described in American Gas Association Report No. 3, Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids. Based on the second and third editions, the calculation method is 1992 AGA 3.

The AGA 7 calculations conform to methods described in American Gas Association Report No. 7, Measurement of Gas by Turbine Meters, and use the AGA 8 method for determining the compressibility factor.

The AGA 8 method calculates the compressibility factor based on the physical chemistry of the component gasses at specified temperatures and pressures.

The firmware supports liquid calculation methods ISO 5167 and API 12. You must supply factors for API 12 correction through a Function Sequence Table (FST) or user program. For more information, refer to the *Function Sequence Table (FST) User Manual* (Part Number D301058X012).

Note: For a complete and current listing of all supported liquid and/gas calculations on the ROC800, refer to the technical specifications *ROC800-Series Operating System Firmware* (ROC800:FW1).

1.5.4 ROC800L Flow Calculations

For the ROC800L, liquid calculation methods include:

- API 2450 (1980)
- ASTM-D1250-04, IP200/04 (same as MPMS Chapter 11)
- API Manual of Petroleum Measurement Standards (MPMS):
  - Chapter 4.6 Pulse Interpolation (small volume proving)
  - Chapter 5.5 Double Pulse Integrity (ISO 6551, IP252)
  - Chapter 11.1 Volume Correction for Temperature and Pressure
  - Chapter 11.2.1, 11.2.1M Pressure Correction (M is for metrics)
  - Chapter 11.2.4 Light Hydrocarbons – GPA TP-27 (2007)
  - Chapter 12.2 Resolution for Displays and Printed Reports
  - Chapter 21.2 Electronic Flow Measurement for Liquids
- NIST Handbook 44
- IP-2 (now EI) (1980) Pressure Effects on Density
- IP-3 (now EI) (1988) Corrects Temp to 20°C
- IEEE Standard 754 (1985) and API 11.1 (2004) Double Precision Floating Point Math (64 Bit)

Note: For a complete and current listing of the supported liquid calculations on the ROC800L, refer to the technical specifications *ROC800L Liquid Application Software* (ROC800:SW1).

1.5.5 Automatic Self Tests

The operating system firmware supports diagnostic tests on the ROC800 hardware, such as RAM integrity, Real-Time Clock operation, input power voltage, board temperature, and watchdog timer.

The ROC800 periodically performs the following self-tests:

- Voltage tests (battery low and battery high) ensure the ROC800 has enough power to run. The ROC800 operates with 12 Volts dc (nominal) power provided either through a PM-12 or PM-24 power input module (see *Figures 3-1* or *3-2*). The LED at the top of each module lights when you apply input power with the proper polarity and startup voltage. For the PM-12 module, apply 9.00 to 11.25 volts DC to the BAT+/BAT- connectors; for the PM-24 module, apply 20 to 30 volts DC to the POWER INPUT +/POWER INPUT – connectors; and for the PM-30 module, apply 10.5 to 30.0 volts DC to the POWER INPUT +/POWER INPUT – connectors.
- The CPU controls the software "watchdog." This watchdog checks the software for validity every 2.7 seconds. If necessary, the processor automatically resets.
- The ROC800 monitors Multi-Variable Sensor(s), if applicable, for accurate and continuous operation.
- A memory validity self-test is performed to ensure the integrity of memory.

1.5.6 Low Power Modes

The ROC800 uses low power operation under predetermined conditions and supports two low power modes, Standby and Sleep.

- **Standby**
  The ROC800 uses this mode during periods of inactivity. When the operating system cannot find a task to run, the ROC800 enters Standby mode. This mode keeps all peripherals running and is transparent to the user. The ROC800 wakes from Standby mode when it needs to perform a task.
- **Sleep**
  The ROC800 uses this mode if it detects a low battery voltage. The System AI Battery Point Number 1 measures the battery voltage and compares it to the LoLo Alarm limit associated with this point. (The default value for the LoLo Alarm limit is 10.6 Volts dc.) When in Sleep mode, AUX_{sw} is turned off. For information on configuring alarms and System AI points, refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

Notes:

- Sleep mode applies **only** to ROC800s using the 12 V dc Power Input module (PM-12).
- The design of the PM-30 and PM-24 power modules does not include the low voltage cutoff feature present in the PM-12 module: should power fall below the set LoLo alarm (a default

of 10.1V), the PM-12 module ceases to provide power to the backplane. Thus, the module shuts down CPU operations. For the PM-24 and PM-30 modules, when power falls below the LoLo alarm point, the CPU goes into sleep mode. In sleep mode, the backplane still receives power, the DO modules continue to hold their logic, but nothing controls I/O at this point. If you need both the increased power capacity offered by the PM-30 and low voltage cutoff, refer to the options provided in the description of the PM-30 module in *Chapter 3* of this manual.

1.5.7 Proportional, Integral, and Derivative (PID)

The PID Control applications firmware provides Proportional, Integral, and Derivative (PID) gain control for the ROC800 and enables the stable operation of 16 PID loops that employ a regulating device, such as a control valve.

The firmware sets up an independent PID algorithm (loop) in the ROC800. The PID loop has its own user-defined input, output, and override capability.

The typical use for PID control is to maintain a Process Variable at a setpoint. If you configure PID override control, the primary loop is normally in control of the regulating device. When the change in output for the primary loop becomes less or greater (user-definable) than the change in output calculated for the secondary (override) loop, the override loop takes control of the regulating device. When the switchover conditions are no longer met, the primary loop regains control of the device. Parameters are also available to force the PID into either loop or force it to stay in one loop.

1.5.8 Function Sequence Table (FST)

The Function Sequence Table (FST) applications firmware gives analog and discrete sequencing control capability to the ROC800. This programmable control is implemented in an FST, which defines the actions the ROC800 performs using a series of functions. You use the FST Editor in ROCLINK 800 software to develop FSTs

The function is the basic building block of an FST. You organize functions in a sequence of steps to form a control algorithm. Each function step can consist of a label, a command, and associated arguments. Use labels to identify functions and allow branching to specific steps within an FST. You select commands from a library of mathematical, logical, and other command options. Command names consist of up to three characters or symbols. Finally, arguments provide access to process I/O points and retrieve real-time values. A function may have zero, one, or two arguments.

The FST Editor provides a workspace into which you can enter—for each FST—**either** a maximum of 500 lines **or** a maximum of 3000

bytes. Since the total amount of memory each FST uses is based on the number of steps and the commands used in each step and since different commands consume different amounts of memory, estimating the memory usage of an FST is difficult. Only after compiling an individual FST can you conclusively know its memory usage.

For further information on FSTs, refer to the *Function Sequence Table (FST) User Manual* (Part Number D301058X012).

1.6 ROCLINK 800 Configuration Software

ROCLINK 800 Configuration software ("ROCLINK 800") is a Microsoft® Windows®-based program that runs on a personal computer and enables you to monitor, configure, and calibrate the ROC800.

ROCLINK 800 has a standard, easy-to-use Windows interface. Tree-based navigation makes accessing features quick and easy.

Many of the configuration screens, such as stations, meters, I/O, and PIDs, are available while ROCLINK 800 is off-line. This enables you to configure the system while either on-line or off-line with the ROC800.

The Local Operator Interface (LOI local port) provides a direct link between the ROC800 unit and a personal computer (PC). The LOI port uses an RJ-45 connector with standard EIA-232 (RS-232D) pinout. With a personal computer running ROCLINK 800, you can locally configure the ROC800, extract data, and monitor its operation.

Remote configuration is possible from a host computer using a serial or dial-up modem communications line. Configurations can be duplicated and saved to a disk. In addition to creating a backup, this feature is useful when you are similarly configuring multiple ROC800s for the first time, or when you need to make configuration changes off-line. Once you create a backup configuration file, you can load it into a ROC800 by using the Download function.

Access to the ROC800 is restricted to authorized users with correct User ID and password.

Graphical Interface

ROCLINK 800's graphic interface dynamically represents the modules currently installed in your ROC800 and simplifies the configuration process. Move the mouse over a module to highlight it, and click to access the configuration parameter screen for that module (see *Figure 1-3*).

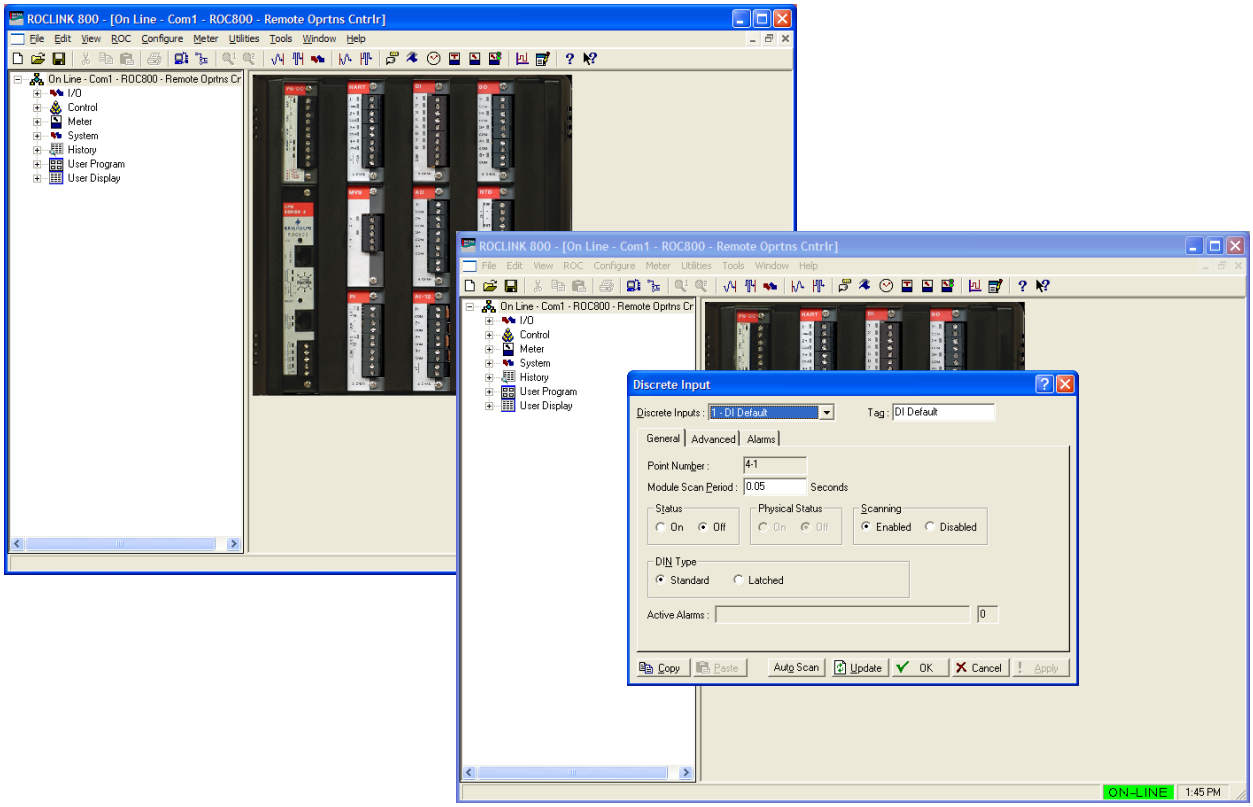

ROCLINK 800 - [On Line - Com1 - ROC800 - Remote Oprtns Cntrlr]
File Edit View ROC Configure Meter Utilities Tools Window Help
On Line - Com1 - ROC800 - Remote Oprtns Cr
I/O
Control
Meter
System
History
User Program
User Display
Discrete Input
Discrete Inputs : 1 - DI Default
Tag : DI Default
General Advanced Alarms
Point Number : 4-1
Module Scan Period : 0.05 Seconds
Status On Off
Physical Status On Off
Scanning Enabled Disabled
DIN Type Standard Latched
Active Alarms :
Copy Paste Auto Scan Update OK Cancel Apply
ON-LINE
1:45 PM

Figure 1-3. ROCLINK 800 Dynamic Graphical Interface

You can build custom displays for the ROC800 that combine both graphic and dynamic data elements. The displays can monitor the operation of the ROC800 either locally or remotely.

You can archive historical values for any numeric parameter in the ROC800. For each parameter configured for historical archiving, the system keeps time-stamped minute, periodic, and daily data values as well as yesterday's and today's daily minimum and maximum values.

You can collect history values from the ROC800 using ROCLINK 800 or another third-party host system. You can view history directly from the ROC800 or from a previously saved disk file. For each history segment, you can configure the number of periodic history values archived, the frequency of archiving the periodic values, the number of daily values archived, and the contract hour.

ROCLINK 800 can create an EFM (Electronic Flow Measurement) report file that contains all the configuration, alarms, events, periodic and daily history logs, and other history logs associated with the stations and meter runs in the ROC800. This file then becomes the custody transfer audit trail.

The SRBX (Spontaneous-Report-By-Exception) alarming feature is available for the host communication ports (Local and dial-up modem ports). SRBX allows the ROC800 to contact the host to report an alarm condition.

Use ROCLINK 800 to:

- Configure and view Input/Output (I/O) points, flow calculations, meter runs, PID control loops, system parameters, and power management features.
- Retrieve, save, and report historical data.
- Retrieve, save, and report events and alarms.
- Perform five-point calibration on AI, RTD, and Multi-Variable Sensor MVS) inputs.
- Implement user security.
- Create, save, and edit graphical displays.
- Create, save, edit, and debug Function Sequence Tables (FSTs) of up to 500 lines each.
- Set up communication parameters for direct connection, telephone modems, and other communications methods.
- Configure Modbus parameters.
- Set up radio power control.
- Update the firmware.

1.7 ROC800L Software

The ROC800L (available in either a ROC809L or ROC827L configuration) manages and measures the flow of liquid hydrocarbons through meters using a suite of factory-installed software programs:

- **Liquid Calculations**:
  Configures liquid preferences, products, stations, meters, and density derivation to accurately measure the liquid flow through a meter and perform density, temperature, and pressure corrections.
- **Batching**:
  Configures and schedules multiple batches to record and control the flow of a liquid. Batching provides user-defined variables for both re-calculation and retroactive calculation to improve batch accuracy.
- **Proving**:
  Controls meter proving by operating a four-way control valve, calculating a new meter factor, and storing meter factor information on up to 24 products for each of up to six meters. The program supports uni-directional, bi-directional, large volume, small volume, and master meter proving.
- **Reporting**:
  Generates printable reports in compliance with API, MPMS Chapter 12.2.2 and 12.2.3. You can create customized reports using ROCLINK 800 Configuration software.

- **Batch Queuing**:
  Sequences future batches, if appropriate for your organization. Used in conjunction with the batching program.

Note: The integrity of metrology results is critical to the measurement aspects of the ROC800L. You can lock certain configuration parameters to ensure the accuracy of liquid hydrocarbon calculations.

1.8 DS800 Development Suite Software

DS800 Development Suite software allows you to program in any one of the five IEC 61131-3 languages. You can download DS800 applications to a ROC800 over a serial or Ethernet port, independently of the ROCLINK 800 software.

DS800 Development Suite software allows you to program in all five of the IEC 61131-3 languages:

- Ladder Logic Diagrams (LD).
- Sequential Function Chart (SFC).
- Function Block Diagram (FBD).
- Structured Text (ST).
- Instruction List (IL).

A Flow Chart language provides a sixth programming language. With these six languages, FSTs, and built-in functionality, you can configure and program the ROC800 in an environment in which you are comfortable.

You can download and implement programs developed in the DS800 Development Suite software in the ROC800 in addition to—or as an alternative to—FST programs. DS800 software has definite benefits for programmers who prefer to use the IEC 61131-3 languages, who desire to multi-drop units in a distributed architecture, or who desire enhanced program diagnostics capabilities.

Additional DS800 Development Suite software features include:

- Cross-reference (bindings) between variables in separate ROC800 units.
- Variable Dictionary.
- Off-line simulation for diagnostics and testing.
- On-line modification of programs.
- On-line debugging of programs.
- User developed functions and function blocks.
- User defined templates.
- Creation and support of user defined libraries.

1.9 Expansion Backplane

The expansion backplane is a key component to the ability of the ROC827 to expand its I/O capabilities to meet your needs. The ROC827 base unit can accommodate up to four additional expansion backplanes, which easily snap together. This increases the total number of available I/O slots to 27. Refer to *Chapter 2, Installation and Use*, for instructions on adding backplanes to the ROC827 base unit. Refer to *Chapter 3, Power Connections*, to assess the power requirements for any particular I/O configuration.

1.10 FOUNDATION™ Fieldbus Interface

The FOUNDATION Fieldbus ("FFbus") Interface is a microprocessor-based solution that, when connected to a ROC800-Series controller, enables you to configure and manage up to four H1 interface modules. You can house the FFbus Interface either as a stand-alone unit or as part of a Series 2 ROC800 assembly.

Each H1 module can communication with up to 16 remote fieldbus-compliant devices, enabling you to manage up to 64 remote fieldbus devices for each FFbus Interface.

Additionally, the Interface is designed to share fieldbus device data with one or more ROC800s, creating a broad network of device information.

For detailed information on how to install and use the FFbus Interface with the ROC800, refer to the *FOUNDATION Fieldbus Interface Instruction Manual* (Part Number D301461X012) and the *Field Interface Configurator User Manual* (Part Number D301575X012).

1.11 Additional Technical Information

Refer to the following technical documentation (available at *www.EmersonProcess.com/Remote*) for additional and most-current information.

Table 1-5. Additional Technical Information

Name	Form Number	Part Number
ROC800-Series Remote Operations Controller	ROC800	D301155X012
ROC800L Remote Operations Controller	ROC800:800L	D301678X012
ROC800-Series Operating System Firmware	ROC800:FW1	D301156X012
ROC800L Liquid Application Software	ROC800:SW1	D301576X012
FOUNDATION™ Fieldbus Interface (ROC800-Series)	ROC800:FFI	D301650X012
FOUNDATION™ Fieldbus Interface Instruction Manual	A6259	D301461X012
Field Interface Configurator User Manual	A6250	D301575X012
ROCLINK 800 Configuration Software User Manual (for ROC800-Series)	A6218	D301250X012
ROCLINK 800 Configuration Software User Manual (for ROC800L)	A6214	D301246X012
ROC800-Series Alternating Current I/O Module	ROC800:ACIO	D301243X012

Chapter 2 – Installation and Use

This chapter describes the ROC800-Series housing (case), backplane (electronic connection board at the back of the housing), CPU (central processing unit), and the expansion backplane (EXP). This chapter provides a description and specifications of these hardware items and explains installation and startup of the ROC800-Series.

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2.1 Installation Requirements

The ROC800's design makes it highly adaptable to a wide variety of installations. Consequently, this manual cannot cover all possible installation scenarios. Contact your local sales representative if you require information concerning a specific installation not described in this manual.

Planning is essential to a good installation. Because installation requirements depend on many factors (such as the application, location, ground conditions, climate, and accessibility), this document only provides generalized guidelines.

2.1.1 Environmental Requirements

Always install the ROC800 in a user-supplied building or enclosure to protect it from direct exposure to rain, snow, ice, blowing dust or debris, and corrosive atmospheres. If you install the ROC800 outside of a building, it must be placed in a National Electrical Manufacturer's Association (NEMA) 3 or higher rated enclosure to ensure the necessary level of protection.

Note: In salt spray environments, it is especially important to ensure that the enclosure—including all entry and exit points—is sealed properly.

The ROC800 operates over a wide range of temperatures. However, in extreme climates it may be necessary to provide temperature-controlling devices to maintain stable operating conditions. In extremely hot climates, a filtered ventilation system or air conditioning may be required. In extremely cold climates, it may be necessary to provide a thermostatically controlled heater in the same enclosure as the ROC800. To maintain a non-condensing atmosphere inside the ROC800 enclosure in areas of high humidity, it may be necessary to add heat or dehumidification.

2.1.2 Site Requirements

When locating the ROC800 on the site, careful consideration can help reduce future operational problems. Consider the following items when choosing a location:

- Local, state, and federal codes often place restrictions on locations and dictate site requirements. Examples of these restrictions are fall distance from a meter run, distance from pipe flanges, and hazardous area classifications. Ensure that all code requirements are met.
- Choose a location for the ROC800 to minimize the length of signal and power wiring.
- Locate ROC800s equipped for radio communications so the antenna has an unobstructed signal path. Antennas should not be aimed into storage tanks, buildings, or other tall structures. If possible, antennas should be located at the highest point on the site. Overhead clearance should be sufficient to allow the antenna to be raised to a height of at least twenty feet.
- To minimize interference with radio communications, choose a location for the ROC800 away from electrical noise sources, such as engines, large electric motors, and utility line transformers.
- Choose a location for the ROC800 away from heavy traffic areas to reduce the risk of being damaged by vehicles. However, provide adequate vehicle access to aid monitoring and maintenance.

- The site must comply with class limits of Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) The device may not cause harmful interference, and (2) the device must accept any interference received, including interference that may cause undesired operation.

2.1.3 Compliance with Hazardous Area Standards

The ROC hazardous location approval is for Class I, Division 2, Groups A, B, C, and D. The Class, Division, and Group terms include:

- **Class** defines the general nature of the hazardous material in the surrounding atmosphere. Class I is for locations where flammable gases or vapors may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.
- **Division** defines the probability of hazardous material being present in an ignitable concentration in the surrounding atmosphere. Division 2 locations are locations that are presumed to be hazardous only in an abnormal situation.
- **Group** defines the hazardous material in the surrounding atmosphere. Groups A to D are:
  - Group A: Atmosphere containing acetylene.
  - Group B: Atmosphere containing hydrogen, gases, or vapors of equivalent nature.
  - Group C: Atmosphere containing ethylene, gases, or vapors of equivalent nature.
  - Group D: Atmosphere containing propane, gases, or vapors of equivalent nature.

For the ROC800 to be approved for hazardous locations, it must be installed in accordance with the National Electrical Code (NEC) guidelines or other applicable codes.

⚠ Caution **When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.**

2.1.4 Power Installation Requirements

Be sure to route power away from hazardous areas, as well as sensitive monitoring and radio equipment. Local and company codes generally provide guidelines for installations. Adhere rigorously to all local and National Electrical Code (NEC) requirements.

The removable terminal blocks accept 12 to 22 American Wire Gauge (AWG) wiring.

Although the ROC800 can operate on different DC voltages based on the installed Power Input module, it is good practice when using a battery-backed system to install a low-voltage cutoff device to help protect batteries and other devices the ROC800 does not power. Similarly, when the ROC800 uses a PM-24 Power Input module with a 24 V dc battery-backed system, it is a good practice to install an appropriate low voltage cutoff device to protect the battery back-up.

2.1.5 Grounding Installation Requirements

If your company has no specific grounding requirements, install the ROC800 as a floating system (unconnected to ground). Otherwise, follow your company's specific grounding practices. However, if you are making a connection between a grounded device and the ROC800 EIA-232 (RS-232) port, ground the ROC800 Power Input module either by connecting the PM-12's BAT– to ground or by connecting either of the PM-24 or PM-30 module's negative Power Inputs to ground.

The National Electrical Code (NEC) governs the ground wiring requirements. When the equipment uses a DC voltage source, the grounding system must terminate at the service disconnect. All equipment grounding conductors must provide an uninterrupted electrical path to the service disconnect. This includes wire or conduit carrying the power supply conductors.

- The *National Electrical Code Article 250-83 (1993)*, paragraph c, defines the material and installation requirements for grounding electrodes.
- The *National Electrical Code Article 250-91 (1993)*, paragraph a, defines the material requirements for grounding electrode conductors.
- The *National Electrical Code Article 250-92 (1993)*, paragraph a, provides installation requirements for grounding electrode conductors.
- The *National Electrical Code Article 250-95 (1993)* defines the size requirements for equipment grounding conductors.

Improper grounding or poor grounding practice can often cause problems, such as the introduction of ground loops into your system.

Proper grounding of the ROC800 helps to reduce the effects of electrical noise on the ROC800's operation and protects against lightning.

Install a surge protection device at the service disconnect on DC voltage source systems to protect against lightning and power surges for the installed equipment. All earth grounds must have an earth to ground rod or grid impedance of 25 ohms or less as measured with a ground system tester. You may also consider a telephone surge protector for the dial-up modem communications module.

A pipeline with cathodic protection is not a good ground. Do not tie common to the cathodic part of the pipeline.

When connecting shielded cable, be sure to tie the shielded cable to earth ground at the end of the cable attached to the ROC800 only. Leave the other end of the shielded cable open to avoid ground loops.

2.1.6 I/O Wiring Requirements

I/O wiring requirements are site- and application-dependent. Local, state, and NEC requirements determine the I/O wiring installation methods. Direct buried cable, conduit and cable, or overhead cable are all options for I/O wiring installations.

Shielded, twisted-pair cable is recommended for I/O signal wiring. The twisted-pair minimizes signal errors caused by Electro-Magnetic Interference (EMI), Radio Frequency Interference (RFI), and transients. Use insulated, shielded, twisted-pair wiring when using MVS signal lines. The removable terminal blocks accept 12 to 24 AWG wire.

2.2 Required Tools

Use the following tools to perform installation and maintenance procedures on the ROC800.

- Phillips screwdriver, size 0.
- Flat blade screwdriver, size 2.5 mm (0.1 inch).
- Flat blade screwdriver, large, or other prying instrument.

2.3 Housing

The housing case is made of a patented Acrylonitrile Butadiene Styrene (ABS) plastic (U.S. Patent 6,771,513) and the wire channel covers are made of polypropylene plastic.

2.3.1 Removing and Replacing End Caps

Normal use and maintenance of the ROC800 does not typically require you to remove the end caps on the housing. Follow these procedures in case removal is necessary.

To remove the end caps:

1. Place the tip of a flat-blade screwdriver into the top pry hole of the end cap and loosen the end cap by pulling the handle of the screwdriver away from the backplane.

   Note: The pry holes are located on the sides of the end caps.

2. Place the tip of a flat-blade screwdriver into the bottom pry hole of the end cap and loosen the end cap by pulling the handle of the screwdriver away from the backplane.
3. Pivot the front end cap away from the back edge of the housing.

To replace the end caps:

1. Align the back edge of the end cap on the housing.
2. Rotate the end cap towards the housing and snap the end cap into place.

2.3.2 Removing and Installing Wire Channel Covers

Install the wire channel covers over the wiring channels once the wiring of the terminal blocks is complete. Wire channel covers are located on the front of the ROC800 housing.

To remove a wire channel cover:

1. Grasp the wire channel cover at both the top and bottom.
2. Start at the top or bottom and pull the wire channel cover out of the wire channel.

To replace a wire channel cover:

1. Align the wire channel cover over the wire channel, allowing unobstructed wire access.
2. Press the wire channel cover into place until it snaps.

Note: The tabs on the left side of the wire channel cover should rest in the slots on the left edge of the channel.

2.3.3 Removing and Installing Module Covers

Before you insert an I/O or communications module, remove the module cover over the empty module slots in which you intend to install the modules. Although you are not required to remove the power to the ROC800 to perform this procedure, caution is always advisable when working with a powered ROC800.

⚠ Caution

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions (such as wearing a grounded wrist strap).

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To remove a module cover:

1. Remove the wire channel cover.
2. Unscrew the two captive screws on the face of the cover.
3. Using the tab at the left side of the removable terminal block, pull the module cover straight out from the ROC800 housing.

Note: If you remove a module for an extended period, install a module cover plate over the empty module slot to keep dust and other matter from getting into the ROC800.

To install a module cover:

1. Place the module cover over the module slot.
2. Screw the two captive screws on the module cover plate.
3. Replace the wire channel cover.

2.4 Mounting the ROC800 on a DIN Rail

When choosing an installation site, be sure to check all clearances. Provide adequate clearance for wiring and service. The ROC800 mounts on Type 35 DIN rails and requires two strips of DIN rail. Refer to *Figures 2-1*, *2-2*, and *2-3*.

Note: English measurement units (inches) appear in brackets in the following figures.

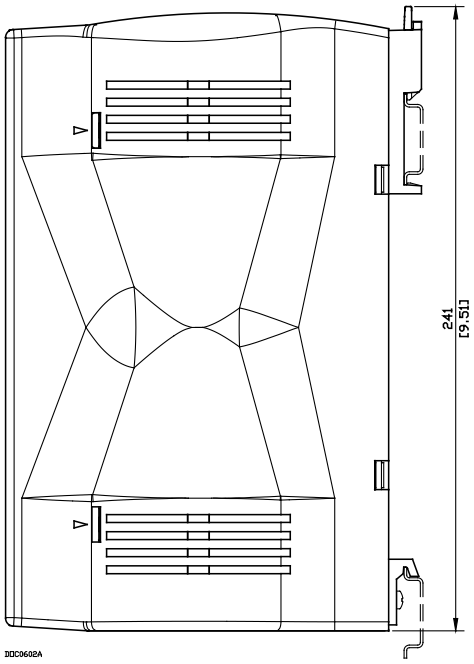


Figure 2-1. Side View of the ROC800

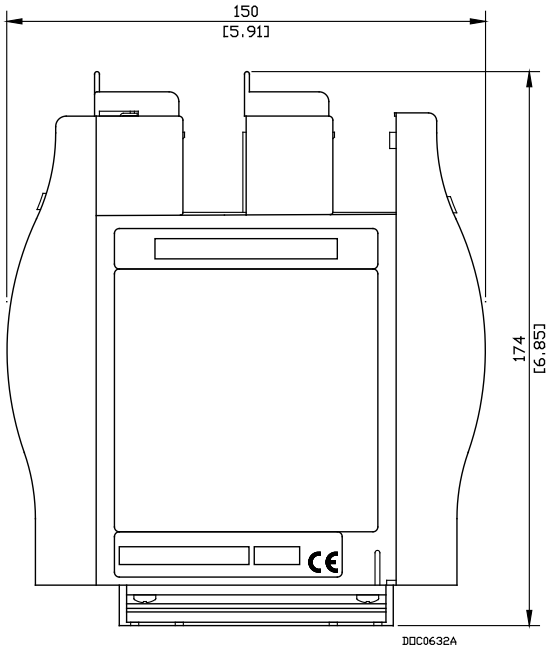
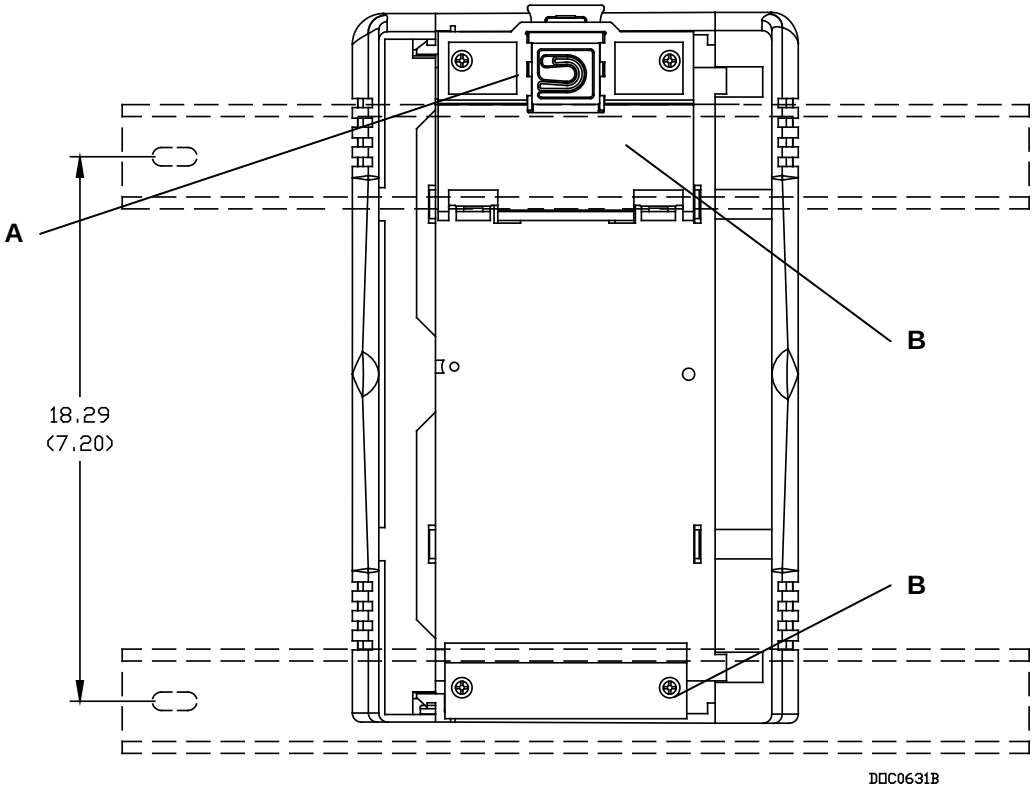


Figure 2-2. Bottom View of the ROC800

Note: The distance from the mounting panel to the front of the ROC800 is 174mm (6.85”). If you mount the ROC800 inside an enclosure and want to connect a cable to the LOI or Ethernet port, ensure adequate clearance for the cable and the enclosure door. For example, a molded RJ-45 CAT 5 cable can increase the clearance requirement for the enclosure by 25mm (1”).



A DIN Rail Catch
B DIN Rail Mount

Figure 2-3. Back View of the ROC800

2.4.1 Installing the DIN Rail

To install the ROC800 using the 35 x 7.5 mm DIN rails:

1. Mount the lower DIN rail onto the enclosure panel.
2. Snap the upper DIN rail into the ROC800 upper DIN rail mounting blocks.
3. Place the ROC800 onto the lower rail that is mounted to the plane and ensure that the ROC800 (with the second strip of DIN rail still in its upper mounting blocks) is seated against the panel.
4. Fasten the upper strip of DIN rail to the panel.

Note: Following this procedure (which uses the ROC800 to provide the correct DIN rail spacing) ensures that the ROC800 is held securely in place.

2.4.2 Securing the ROC800 to the DIN Rail

When placed correctly, the DIN rail catches (see *Figure 2-3*) secure the ROC to the DIN rail. Place the catches according to the following configuration:

- ROC809: Two catches.
- ROC827: One catch.
- ROC827 and one EXP: Place catches on ROC827 and EXP.
- ROC827 and two EXPs: Place catches on ROC827 and second EXP.
- ROC827 and three EXPs: Place catches on ROC827 and third EXP.
- ROC827 and four EXPs: Place catches on ROC827 and second and fourth EXP.

2.4.3 Removing the ROC800 from the DIN Rail

To remove the ROC800 from DIN rails, gently lever the DIN rail catches (located on the top of the housing) up approximately 3-4mm (1/8”). Then tilt the top of the ROC800 away from the DIN rail.

2.5 ROC800-Series Expansion Backplane (EXP)

The expansion backplane has connectors for the central processing unit (CPU), the power input module, and all the I/O and communication modules. Once a module is completely inserted into the module slot, the connector on the module fits into one of the connectors on the backplane. The backplane does not require any wiring, so no jumpers are associated with the backplane.

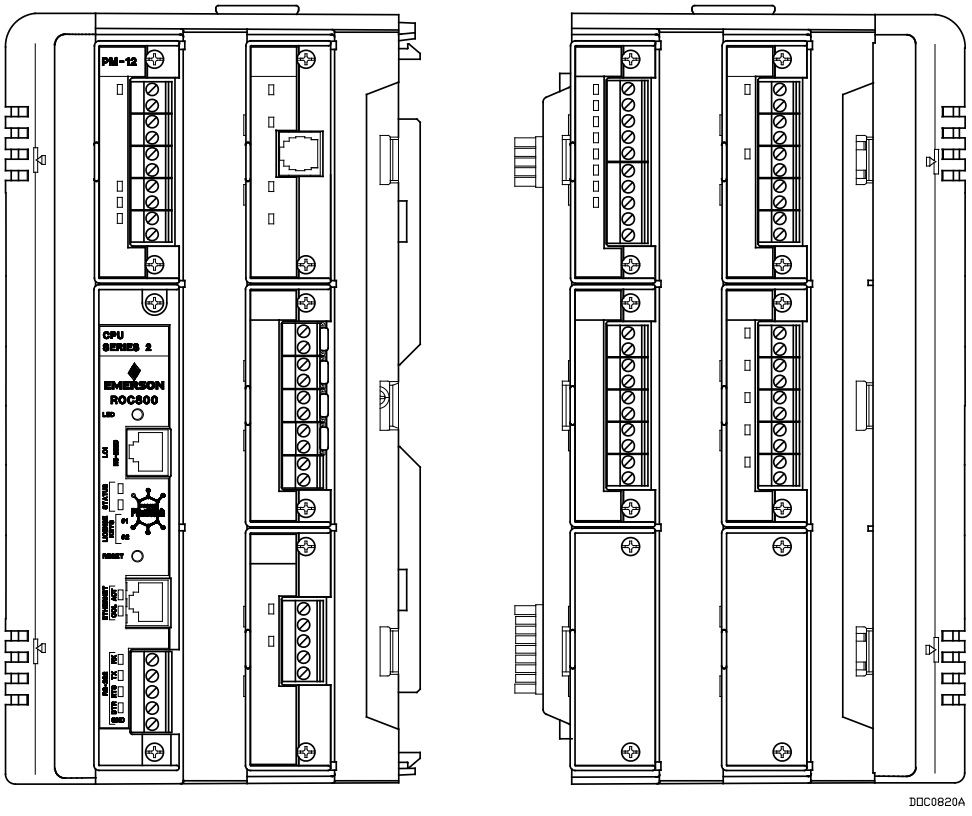


Figure 2-4. ROC827 and Expansion Backplane

Removing the backplane from the housing is not recommended, as there are no field serviceable parts. If the backplane requires maintenance, please contact your local sales representative.

2.5.1 Attaching an Expansion Backplane

To attach an EXP to an existing ROC827 base unit or to another EXP:

1. Remove power from the ROC827.
2. Remove the right-hand end cap from the ROC827 as described in *Section 2.3.1, Removing and Replacing End Caps*.

   Note: The EXP may not have attached end caps. If it does, remove the left-hand end cap.

3. Remove the wire channel covers from the ROC827 as described in *Section 2.3.2, Removing and Installing Wire Channel Covers*.
4. Align and gently press together the front right edge of the EXP against the front left edge of the ROC827. This aligns the power connectors on the EXP's backplane with the socket on the ROC827's backplane (see *Figure 2-5*).

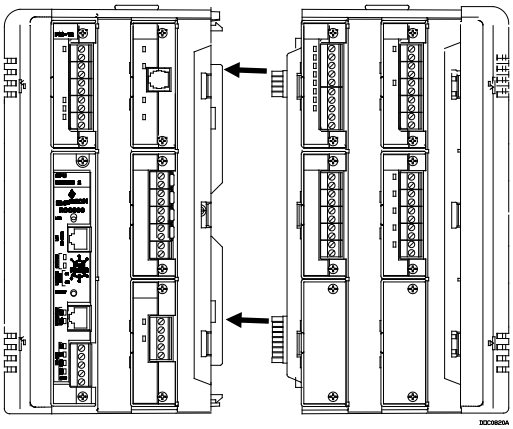


Figure 2-5. Power Connectors on the EXP Backplane

5. Pivot the back edges of the ROC827 and the EXP toward each other until they click together.

   Note: The plastic locking clips at the back of the EXP click when the two units securely fasten together.

6. Attach an end cap to the right side of the EXP (if it does not have one). Do not replace the wire channel covers until you finish installing and wiring the modules in the EXP.

Note: Adding an EXP–and the modules it will hold–may require you to adjust your ROC827's power consumption requirements. Refer to *Section 3.2, Determining Power Consumption*.

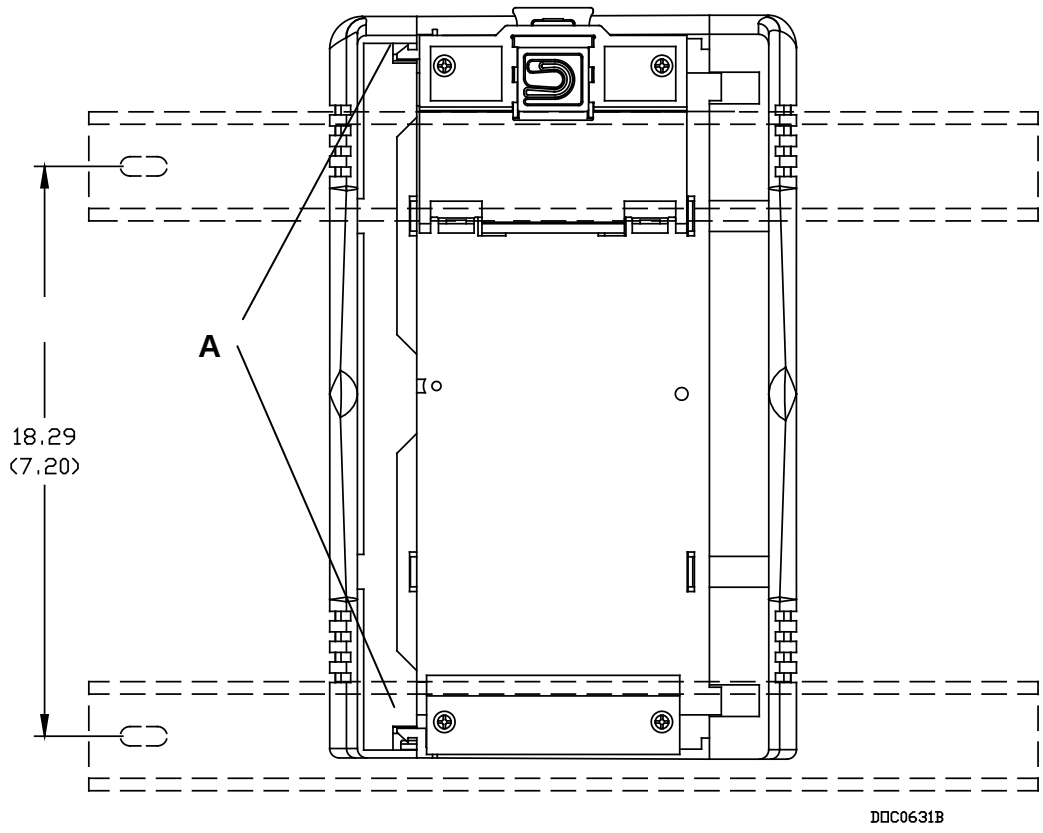
2.5.2 Removing an Expansion Backplane

Note: Before you remove an EXP, you must power down the ROC827, disconnect **all** wiring from **all** modules, and remove the **entire** unit from the DIN rail. Once the entire ROC827 is free of the DIN rail, you can detach an individual EXP.

To remove an EXP from an existing ROC827 base unit:

1. Remove the right-hand end cap from the EXP as described in *Section 2.3.1, Removing and Replacing End Caps*.
2. Remove the wire channel covers on either side of the EXP you want to detach, as described in *Section 2.3.2, Removing and Installing Wire Channel Covers*.
3. Turn the ROC827 around so that the back of the unit faces you (as shown in *Figure 2-6*).

Note: It may be useful to place the ROC827 face-down on a flat surface with the EXP you want to detach hanging free of the surface's edge.



A Locking clips and tabs

Figure 2-6. Plastic Snaps on the Back of the EXP

4. Using a flat-bladed screwdriver, gently pry the plastic locking clips at the upper and lower back edge of the EXP housing away from their securing tabs.

   Note: Applying too much pressure breaks the plastic hooks.

5. Once you free the plastic locking clips from their securing tabs, gently pivot the back of the EXP away from the ROC827.

   Note: The EXP detaches quickly. Hold it securely to prevent it from falling.

6. Place the detached EXP in a secure location.
7. Replace the right-hand end cap.
8. Replace the ROC827 on the DIN rail.
9. Reattach all wiring.
10. Replace the wire channel covers.

2.6 Central Processing Unit (CPU)

The ROC800 uses a standard ROC800-Series central processing unit (CPU) containing the microprocessor, the firmware, connectors to the backplane, three built-in communication ports (two with LEDs), a LED low power wakeup button, a RESET button, the application license key connectors, a STATUS LED indicating system integrity, and the main processor (refer to *Figures 2-7* and *2-8* and *Tables 2-1* and *2-2*).

ROC800L The ROC800L functions **only** with a Series 2 CPU.

The 32-bit microprocessor is based on a Motorola MPC862 Quad Integrated Communications Controller (PowerQUICC) PowerPC processor running at 65 MHz.

The internal Sanyo 3-volt CR2430 lithium backup battery provides backup of the data and the Real-Time Clock when the main power is not connected.

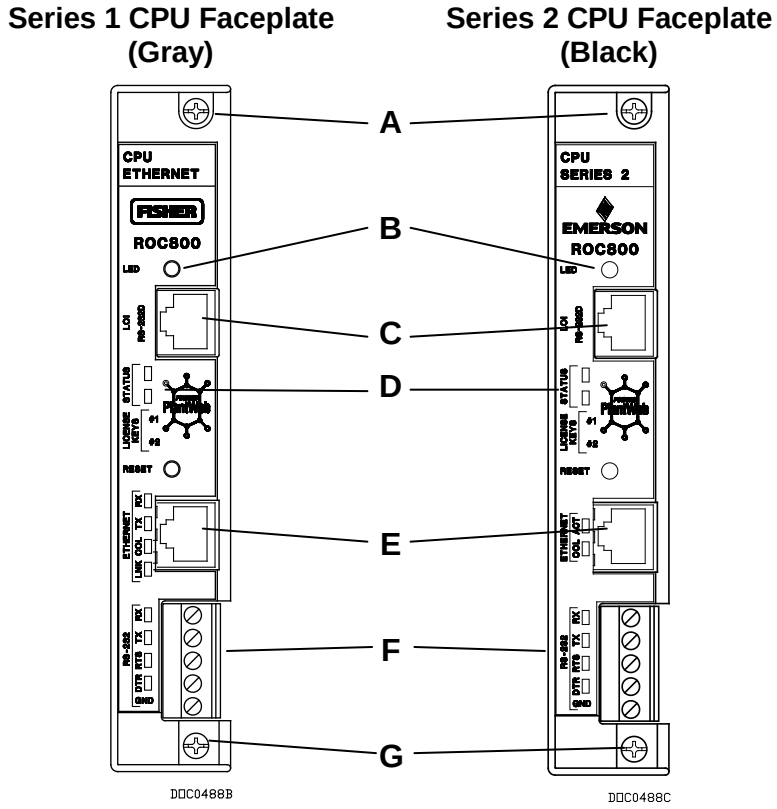
To **disable** the battery backup:

1. Remove power from the ROC800.
2. Remove the CPU module from the ROC800.
3. Move the J3 jumper (see *Figure 2-8*) on the CPU module to the two **upper** pins.
4. Reinstall the CPU module.
5. Power up the unit for 20 seconds and then power down. This activates the “sleep” mode for the backup battery.

To **enable** the battery backup:

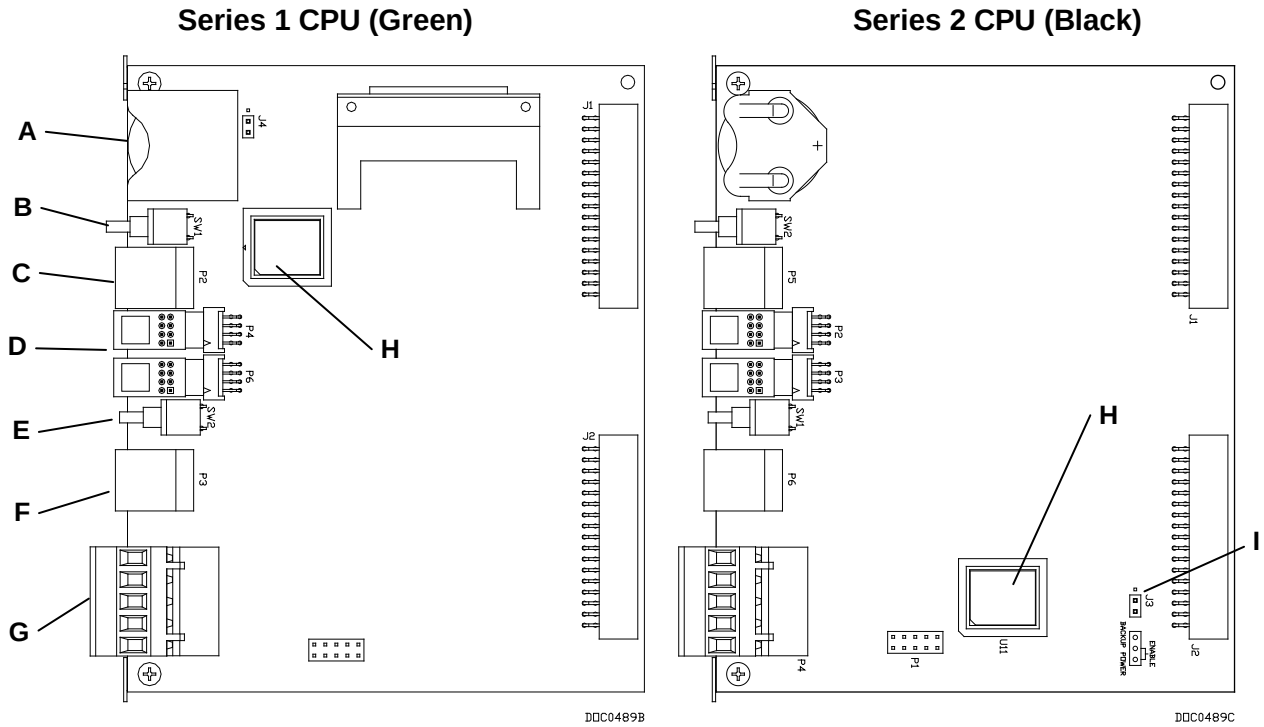
1. Remove power from the ROC800.
2. Remove the CPU module from the ROC800.
3. Move the J3 jumper on the CPU module to the two lower pins.
4. Reinstall the CPU module.
5. Power up the ROC800; the backup battery is fully functional.

You can disable this battery backup on the Series 2 CPU module by moving the J3 jumper (located on the CPU module) to the two upper pins (see *Figure 2-8*).



A Securing Screw
B LED Button
C LOI – EIA-232 (RS-232D)
D Status LED
E Ethernet
F EIA-232 (RS-232C)
G Securing Screw

Figure 2-7. CPU Front View (Series 1 and Series 2 CPU Modules)



A	Battery
B	LED Button
C	RJ-45 Port
D	License Keys
E	RESET Button
F	RJ-45 Port
G	RS-232 Port
H	Microprocessor
I	Battery backup jumper

Figure 2-8. CPU Connectors (Series 1 and Series 2 CPU Modules)

Table 2-1. CPU Connector Locations

CPU Number	Series 1	Series 2
J1	Backplane connector	Backplane connector
J2	Backplane connector	Backplane connector
J3	Not Used	Battery Backup
J4	Battery Backup	Not Used
P2	LOI Port RJ-45	License Key Terminal
P3	Ethernet RJ-45	License Key Terminal
P4	License Key Terminal	RS-232
P5	Not Used	LOI Port RJ-45
P6	License Key Terminal	Ethernet RJ-45
SW1	LED Button	RESET Button
SW2	RESET Button	LED Button

The CPU contains a microprocessor supervisory circuit. This device monitors the battery voltage, resets the processor, and disables the SRAM chip if the voltage goes out of tolerance. The CPU has an

internal Analog to Digital Converter (A/D). The A/D monitors the supply voltage and board temperature (refer to "Automatic Self-Tests" in *Chapter 1, General Information).*

The CPU has two buttons, LED and Reset (see *Figures 2-7* or *2-8*):

- **RESET:**
  - To reset **all** comm ports, stop user programs, stop FSTs, and stop DS800 programs, press and hold in the Reset button for approximately 10 seconds while the ROC800 is powered.

    Note: This feature is not available on the DL8000.
  - To reset the ROC800 configuration to system defaults, remove power, press and hold in the Reset button as you re-apply power to the ROC800. This reset clears all user programs, FSTs, and DS800 programs but retains history, alarms, and events.

Note: The Reset button is recessed to prevent accidental resets. Use the end of a paper clip to access this button.

⚠ Caution **For ROC800 configuration system defaults, when you reset, the ROC800 loses configuration. BEFORE you attempt ANY type of reset, back up your configuration and log data and ensure that you have current versions of user programs and DS800 programs to reload. Refer to "Preserving Configuration and Log Data" in *Chapter 6, Troubleshooting*.**

- **LED:** Press to turn on the LEDs on the CPU module, I/O modules, and communication modules when the ROC800 has timed out.

The STATUS LED helps indicate the integrity of the ROC800 (refer to *Table 2-2*).

Table 2-2. STATUS LED Functions

Status LED	Color	Definitions	Solution
Continually Lit	Green	▪ ROC800 functioning normally.	▪ N/A
Continually Lit	Red	▪ Low Battery Voltage alert.	▪ Charge battery.
		▪ System AI (Point number 1) LoLo Alarm.	▪ Apply DC voltage source.
Flashing	Green	▪ Firmware invalid.	▪ Update firmware.
Flashing	Green-Green to Red-Red	▪ Firmware update in decompression.	▪ **Do not** restart the ROC800.
Flashing	Green to Red	▪ Firmware update is flashing image.	▪ **Do not** restart the ROC800.

To save power, you can enable or disable the LEDs on the ROC800 (with the exception of the LED on the power module). Using ROCLINK 800 (from the ROCLINK 800 menu, select **ROC** > **Flags** and the **Advanced** tab), you can define how long the LEDs remains on after you press the LED button on the CPU module. For instance, with

the default setting of five minutes, all LEDs turn off after five minutes. If you press the LED button, LEDs light and stay lit again for five minutes. By entering a **0** (zero), the LED always stays lit.

2.6.1 Removing the CPU Module

⚠ Caution

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To remove the CPU module:

1. Perform the backup procedure described in *Preserving Configuration and Log Data* in *Chapter 6, Troubleshooting*.
2. Remove power from the ROC800.
3. Remove the wire channel cover.
4. Unscrew the two small screws on the front of the CPU module and remove the faceplate.
5. Place a small screwdriver under the ejector clip at the top or bottom of the CPU module and lightly pry the CPU module out of its socket. You may find it easiest to carefully pry on the top ejector clip a little, then carefully pry the bottom ejector. You will feel and hear the CPU as it detaches from the backplane.
6. Remove the CPU module carefully. Do not scrape either side of the module against the ROC800. Make sure not to pull on any cables attached to the CPU module.

2.6.2 Installing the CPU Module

⚠ Caution

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To install the CPU module:

1. Remove power from the ROC800.
2. Slide the CPU module into the slot.

2. Press the CPU firmly into the slot, ensuring the ejector clips rest on the module rail guides. The connectors at the back of the CPU module fit securely into the connectors on the backplane.
3. Place the CPU faceplate on the CPU.
4. Tighten the two screws on the faceplate of the CPU module firmly (see *Figure 2-7*).
5. Replace the wire channel cover.
6. Review *Restarting the ROC800* in *Chapter 6, Troubleshooting*.
7. Return power to the ROC800 unit.

2.7 License Keys

License keys with valid license codes grant access to applications or, in some cases, allow optional firmware functionality to execute. In some situations, a license key may also be required before you can run the application. Examples of licensed applications include DS800 Development Suite software, meter run calculations, and various user programs. You can then configure these applications using ROCLINK 800 or the DS800 Development Suite software.

The term "license key" refers to the physical piece of hardware (refer to *Figure 2-9*) that can contain up to seven different licenses. Each ROC800 can have none, one, or two installed license keys. If you remove a license key after enabling an application, the firmware disables the task from running. This prevents unauthorized execution of protected applications in a ROC800.

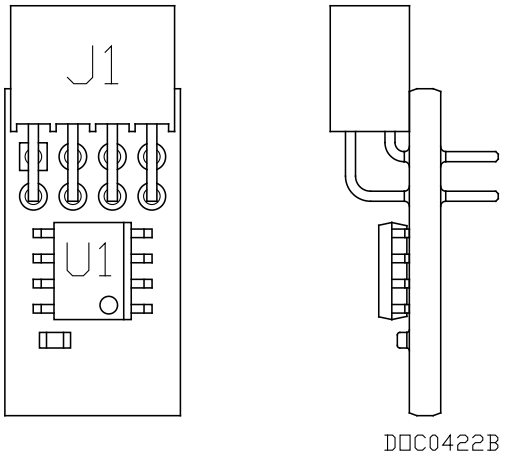


Figure 2-9. License Key

2.7.1 Installing a License Key

⚠ Caution

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To install a license key:

1. Perform the backup procedure described in *Preserving Configuration and Log Data* in *Chapter 6, Troubleshooting*.
2. Remove power from the ROC800.
3. Remove the wire channel cover.
4. Unscrew the captive screws from the CPU faceplate and remove it.
5. Place the license key in the appropriate terminal slot in the CPU (refer to *Figure 2-8*).

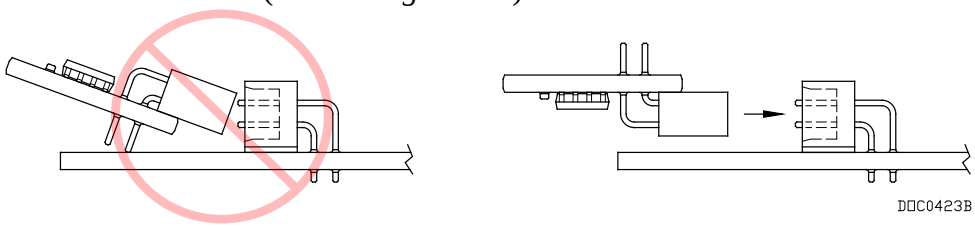


Figure 2-10. License Key Installation

Note: If you are installing a **single** license key, place it the uppermost slot (closest to the LOI port).

6. Press the license key into the terminal until it is firmly seated. Refer to *Figure 2-10*.
7. Replace the CPU faceplate and tighten the two captive screws.
8. Replace the wire channel cover.
9. Review *Restarting the ROC800* in *Chapter 6, Troubleshooting*.
10. Restore power to the ROC800.

2.7.2 Removing a License Key

⚠ Caution

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To remove a license key:

1. Perform the backup procedure described in *Preserving Configuration and Log Data* in *Chapter 6, Troubleshooting*.
2. Remove power from the ROC800.
3. Remove the wire channel cover.
4. Unscrew the captive screws from the CPU faceplate and remove it.
5. Remove the license key from the appropriate terminal slot (P2 or P3) in the CPU (refer to *Figure 2-8*).
6. Replace the CPU faceplate and tighten the two captive screws..
7. Replace the wire channel cover.
8. Review *Restarting the ROC800* in *Chapter 6, Troubleshooting*.
9. Restore power to the ROC800.

2.8 Startup and Operation

Before starting the ROC800, perform the following checks to ensure the unit components are properly installed.

- Make sure the power input module is properly seated in the backplane.
- Make sure I/O and communication modules are seated in the backplane.
- Check the field wiring for proper installation.
- Make sure the input power has the correct polarity.
- Make sure the input power is fused at the power source.

⚠ Caution

Check the input power polarity before connecting power to the ROC800. Incorrect polarity can damage the ROC800.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

2.8.1 Startup

Before you apply power to the ROC800, assess the power requirements (including the base unit, EXPs, and any installed modules and peripheral devices) that comprise the total configuration for your ROC800. Refer to *Determining Power Consumption* in *Chapter 3, Power Connections*.

Apply power to the ROC800 (refer to *Installing a Power Input Module* in *Chapter 3, Power Connections*). The power input module's LED

indicator should light green to indicate that the applied voltage is correct. Then, the STATUS indicator on the CPU should light to indicate a valid operation. Depending on the Power Saving Mode setting, the STATUS indicator may not remain lit during operation (refer to *Table 2-2*).

2.8.2 Operation

Once startup is successful, configure the ROC800 to meet the requirements of the application. Once it is configured and you have calibrated the I/O and any associated Multi-Variable Sensors (MVS, MVSS, MVSI, and so on), place the ROC800 into operation.

⚠ Caution **When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.**

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Chapter 3 – Power Connections

This chapter discusses the Power Input modules. It describes the modules, explains how to install and wire them, and provides worksheets to help you determine—and tune—the power requirements for the I/O and communications modules you can install in the ROC800 and the EXPs.

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3.1 Power Input Module Descriptions

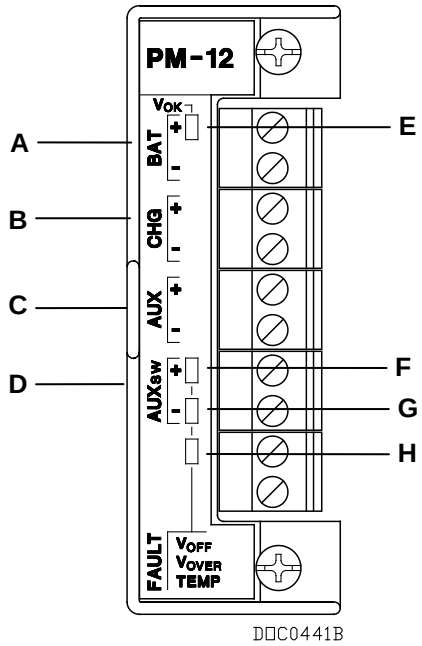
The ROC800 uses a Power Input module to convert external input power to the voltage levels the electronics require. The module also monitors voltage levels to ensure proper operation. Three Power Input modules—12 Vdc (PM-12), 24 Vdc (PM-24) and 30 Vdc (PM-30)—are available for the ROC800.

The power consumption of a ROC800 and any attached expandable backplanes determines the current requirements for the external power supply. Refer to *Section 3.2, Determining Power Consumption* for a discussion and worksheets on assessing power requirements.

The Power Input module has removable terminal blocks for wiring and servicing. The terminal blocks can accept sizes 12 to 22 AWG (American Wire Gauge) wiring.

3.1.1 12-Volt DC Power Input Module (PM-12)

Using the PM-12, the ROC800 can accept 12 Volts dc (nominal) input power from an AC/DC converter or other 12-volt dc supply. The input source should be fused and connected to the BAT+ and BAT– terminals (see *Figure 3-1*). The Power Input module uses 3.3 Volts dc switching power to provide power to the ROC800-Series modules via the backplane. The ROC800 requires 11.5 to 14.5 Volts dc for proper operation.



A BAT+ / BAT–
B CHG+ / CHG–
C AUX+ / AUX–
D AUX_{SW}+ / AUX_{SW}–
E V_{OK} LED
F V_{OFF} LED
G V_{OVER} LED
H TEMP LED

Figure 3-1. 12 Volt dc Power Input Module

The CHG+ and CHG– terminals comprise an Analog Input channel that allows you to monitor an external voltage between 0 to 18 Volts dc. For example, you can connect a solar panel upstream of the solar regulator to monitor the output of the solar panel. This allows you to compare the System AI Point Number 2 for the charging voltage (CHG+) to the actual battery voltage (BAT+) System AI Point Number 1 and take action as required. The module has a low-voltage cut-off circuit built-in to guard against draining power supply batteries. Refer to *Automatic Self Tests* in *Chapter 1, General Information*.

Use the AUX+ / AUX– terminals to supply reverse polarity protected source voltage to external devices, such as a radio or solenoid. Use the AUX_{SW}+ / AUX_{SW}– terminals to provide switched power for external devices. The AUX_{SW}+ is turned off when the ROC800 detects a software configurable voltage at the BAT+ / BAT– terminals.

Table 3-1 details the specific connection information for the 12 volt dc (PM-12) Power Input module. *Table 3-2* indicates the LED fault indicators.

Table 3-1. 12 Volt dc Power Input Terminal Block Connections

Terminal Blocks	Definition	Volts DC
BAT+ and BAT–	Accepts 12 Volts dc nominal from an AC/DC converter or other 12 Volts dc supply.	▪ Maximum Range: 11.5 to 16 Volts dc ▪ Recommended Operating Range: 11.5 to 14.5 Volts dc
CHG+ and CHG–	Analog Input used to monitor an external charging source.	▪ 0 to 18 Volts dc
AUX+ and AUX–	Supplies reverse polarity protected source voltage to external devices. Fused.	▪ 0 to 14.25 Volts dc
AUX_{SW}+ and AUX_{SW}–	Supplies switched power for external devices.	▪ 0 to 14.25 Volts dc

Table 3-2. 12 Volt DC Power Input LED Indicators

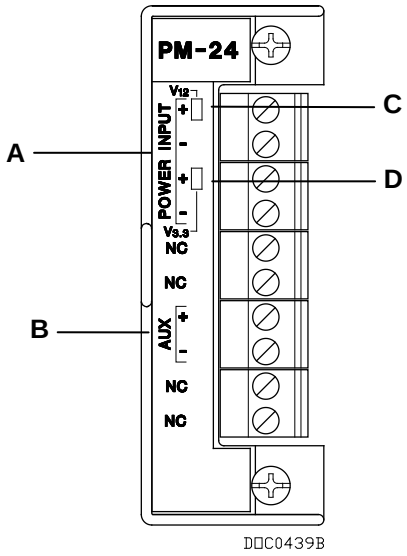
Signal	LED
V_{OK}	Green LED on when voltage is in tolerance on BAT+ and BAT–.
V_{OFF}	Fault – Red LED on when the AUX_{SW}+ output are disabled by the CPU control line.
V_{OVER}	Fault – Red LED on when AUX_{SW}+ is disabled due to excess voltage on BAT+.
TEMP	Fault – Red LED on when AUX_{SW}+ output are disabled due to the excess temperature of the Power Input module.

3.1.2 24-Volt DC Power Input Module (PM-24)

Using the PM-24, the ROC800 can accept 24 Volts dc (nominal) input power from an AC/DC converter or other 24 Volts dc supply connected to the + and – terminals. Connect the input power to either or both of the + and – channels. The 24 V dc Power Input module (PM-24) **does not** have CHG terminals for monitoring a charging voltage, and **does not** monitor the input voltage for alarming, sleep mode, or other monitoring purposes. The module has two LEDs that indicate voltage is received at the backplane and the CPU (see *Figure 3-2* and *Tables 3-3* and *3-4*).

The Power Input module uses 3.3 Volts dc switching power to provide power to the I/O and communications modules installed in the ROC800 and any expanded backplanes. With this Power Input module installed, the ROC800 requires 20 to 30 Volts dc for proper operation.

Use the AUX+ and AUX– terminals to supply reverse polarity protected source voltage to external devices, such as a radio or solenoid.



A + / –
B AUX+ / AUX–
C V_{12} LED
D $V_{3.3}$ LED

Figure 3-2. 24 Volt dc Power Input Module

Table 3-3. 24 Volt dc Power Input Terminal Block Connections

Terminal Blocks	Definition	Volts DC
+ and –	Accepts 24 Volts dc nominal from an AC/DC converter or other 24 Volts dc supply.	20 to 30 Volts dc
AUX+ and AUX–	Supplies reverse polarity protected source voltage to external devices. Circuit limited.	+12 Volts dc minus ~0.7 Volts dc

Table 3-4. 24 Volt dc Power Input LED Indicators

Signal	LED
V_{12}	Green LED on when voltage is provided to backplane.
$V_{3.3}$	Green LED on when voltage is provided to CPU.

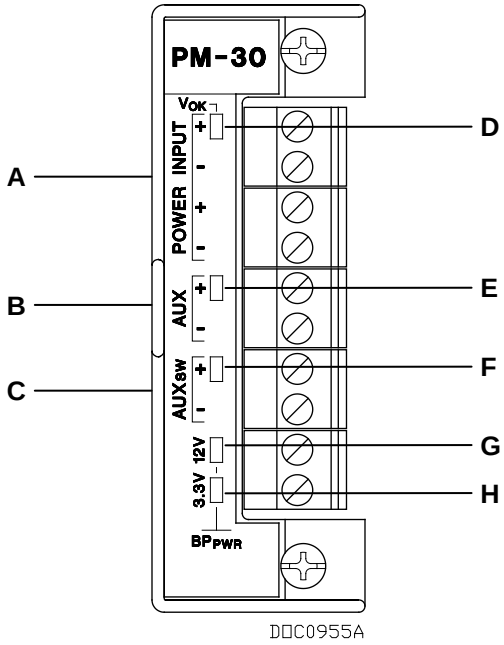
3.1.3 30-Volt DC Power Input Module (PM-30)

Using the PM-30, the ROC800 can accept up to 30 Volts dc (nominal) input power from an AC/DC converter or other 30 Volts dc supply connected to the + and – terminals. Connect the input power to either or both of the + and – channels. The PM-30 module does not have CHG terminals for monitoring a charging voltage, and does not monitor the input voltage for alarming, sleep mode, or other monitoring purposes. The module has two LEDs that indicate voltage is received at the backplane and the CPU (see *Figure 3-3* and *Tables 3-3* and *3-4*).

The module uses 3.3 Volts dc switching power to provide power to the I/O and communications modules installed in the ROC800 and any

expanded backplanes. With this module installed, the ROC800 requires 10.5 to 30 Volts dc for proper operation.

Use the AUX+ and AUX– terminals to supply reverse polarity protected source voltage to external devices, such as a radio or solenoid.



A Power Input Voltage + / –
B AUX+ / AUX–
C AUX_{SW}+ / AUX_{SW}–
D Voltage present at Power Input
E AUX Output enabled
F Switched AUX Output enabled
G 12v power to backplane
H 3.3v power to backplane

Figure 3-3. PM-30 module

Table 3-5. 30 Volt dc Power Input Terminal Block Connections

Terminal Blocks	Definition	Volts DC
Power input +/- +/-	Accepts 11-30Vdc nominal from an AC/DC converter or other dc voltage supply	11 to 30 Volts dc
Aux +/-	Supplies reverse polarity protected source voltage to external devices. Circuit limited (.9A +/- 10%)	Input Voltage minus .7Vdc
Aux $_{SW}$ +/-	Supplies reverse polarity protected source voltage to external devices. Circuit limited (.9A +/- 10%)	Input Voltage minus .7Vdc

Table 3-6. 30 Volt dc Power Input LED Indicators

Signal	LED
V_{ok}	Indicates voltage is in tolerance on BAT+ and BAT-
V_{12}	Indicates the module is providing voltage to backplane
$V_{3.3}$	Indicates the module is providing voltage to backplane
Aux	Indicates the Auxiliary Output Power is enabled
Aux_{SW}	Indicates the Switched Auxiliary Output Power is enabled

Low Voltage Cutoff

The design of the PM-30 power module (like the PM-24 power module it replaces) does not include the low voltage cutoff feature present in the PM-12 power module. In the PM-12 module, when power falls below the set LoLo alarm (a default of 10.1V), the module ceases to provide power to the backplane. Thus, the module shuts down CPU operations.

Remote Automation Solutions continues to offer the PM-12 for installations requiring low voltage cutoff. Neither the PM-24 or the PM-30 has the low voltage cutoff feature. However, if you need low voltage cutoff, we suggest one of the following solutions:

- **Place a low voltage disconnect device between the ROC800 and power source.** Placing a commercially available low voltage disconnect device between the power source and the ROC800 provides the low voltage cutoff protection. Many low voltage disconnect devices have user-selectable disconnect values for a variety of voltages.

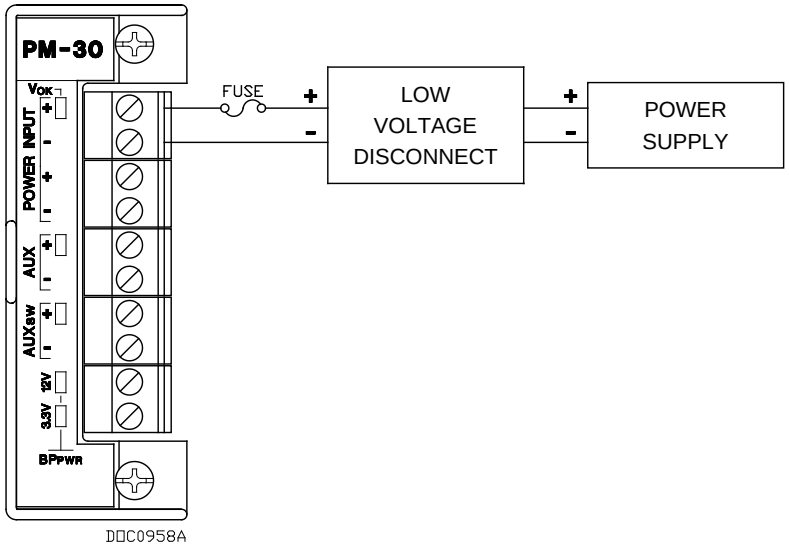


Figure 3-4. Low voltage disconnect device between the ROC800 and power source

- **Place a low voltage disconnect device between the solar regulatory circuitry and the ROC800.** Placing a low voltage disconnect device between the solar regulatory circuit and the ROC800 provides the low voltage cutoff protection. Many low voltage disconnect devices have user-selectable disconnect values for a variety of voltages.

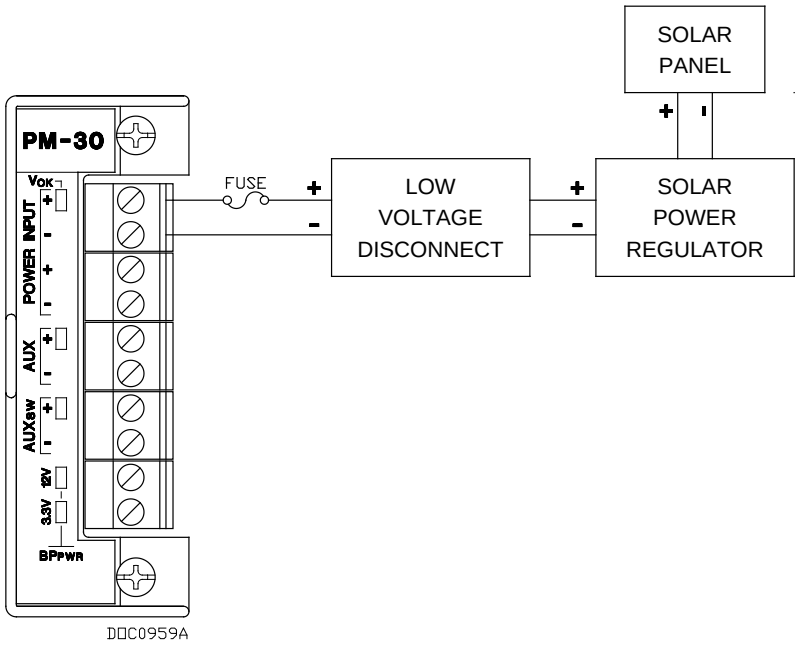


Figure 3-5. Low voltage disconnect device between the solar regulatory circuitry and the ROC800

- **Use the Auxiliary Switch (AUX SW) output terminals on the PM-30**. If shutting down power to an external device is sufficient, then connecting to the Auxiliary Switch (AUX SW) terminals on the PM-30 power module ensures power is cut off when the LoLo alarm is triggered. This may be the preferred solution if the ROC800 provides critical controls. When the LoLo alarm is triggered and the ROC800 CPU goes into sleep mode, it cuts power to the Auxiliary Switch (AUX SW) terminals.

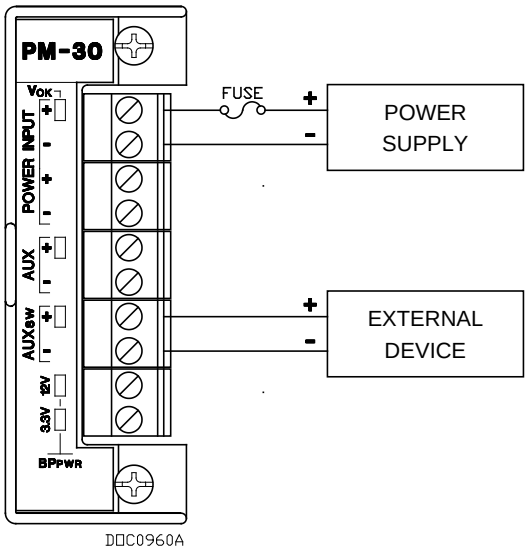


Figure 3-6. Auxiliary Switch (AUX SW) output terminals on the PM-30

3.1.4 Auxiliary Output (AUX+ and AUX–)

You can use the AUX+ and AUX–terminals to supply reverse polarity protected source voltage to external devices, such as a radio or a solenoid. All module terminal blocks accept 12 to 22 AWG wiring. Refer to *Figures 3-3* and *3-4*.

PM-12 For the 12-volt dc Power Input module (PM-12), the auxiliary output follows the voltage located at BAT+ minus ~0.7 Volts dc, which is the protection diode voltage drop. For example, if the BAT+ voltage is 13 volts dc, then AUX+ is ~12.3 Volts dc.

For the 12-volt dc Power Input module, AUX+ / AUX– is always on and is current-limited by a fast-acting glass 2.5 Amp x 20 mm fuse. In the event that the fuse blows, CSA requires that you replace the 2.5 Amp fast-acting fuse with a Little Fuse 217.025 or equivalent. Refer to *Automatic Self Tests* in *Chapter 1, General Information*.

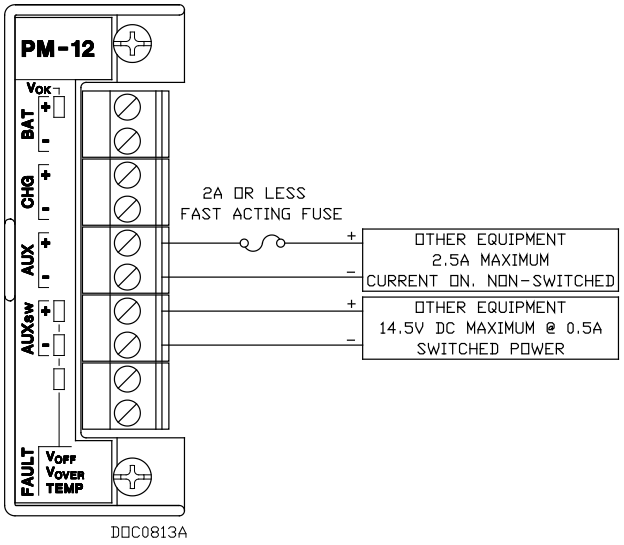


Figure 3-7. Auxiliary Power Wiring for PM-12 Module

PM-24 For the 24 volt dc Power Input module (PM-24), the AUX voltage is always 12 Volts dc minus ~0.7 Volts. AUX+ / AUX– is internally current-limited by a 0.5 Amp Positive Temperature Coefficient (PTC).

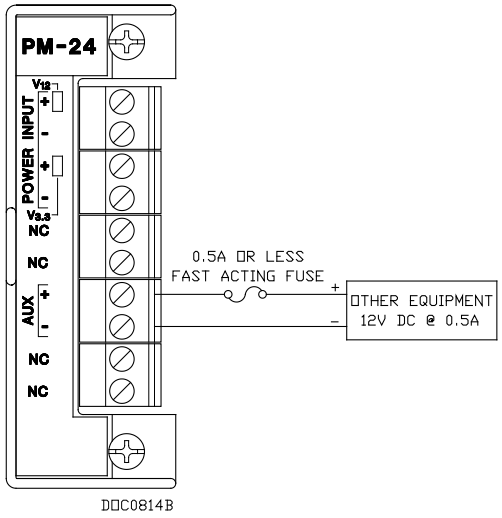


Figure 3-8. Auxiliary Power Wiring for PM-24 Module

PM-30 For the 30 volt dc Power Input module (PM-30), the auxiliary output follows the voltage located at BAT+ minus ~1.0 Volts dc, which is the protection diode voltage drop. For example, if the BAT+ voltage is 13 volts dc, then AUX+ is ~12.3 Volts dc.

For the PM-30 Power Input module, AUX+ / AUX– is always on and is internally current-limited by a .9 Amp Positive Temperature Coefficient (PTC).

If you need to cycle power to the radio or other device to reduce the load on the power source (a recommended practice when using batteries), use a Discrete Output (DO) module to switch power on and off. (The PM-12 and PM-30's on-board AUX_{SW+} and AUX_{SW-} terminals perform this function.) Refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

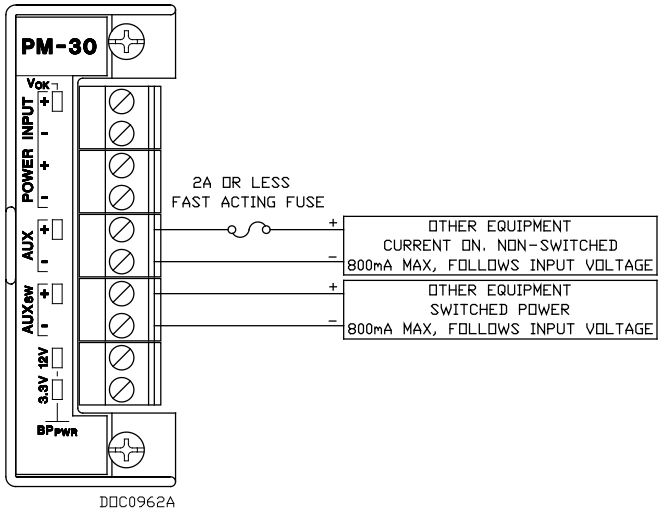


Figure 3-9. Auxiliary Power Wiring for PM-30 Module

Removing the Auxiliary Output Fuse

To remove the auxiliary output fuse:

1. Perform the procedure described in *Section 3.3, Removing a Power Input Module.*
2. Remove the fuse located at F1 on the Power Input module.

Installing the Auxiliary Output Fuse

To re-install the auxiliary output fuse:

1. Replace the fuse located at F1 on the Power Input module.
2. Perform the procedure described in *Section 3.4, Installing a Power Input Module*.

3.1.5 Switched Auxiliary Output (AUXSW+ and AUXSW–)

PM-12

The AUX_{SW}+ and AUX_{SW}–terminals on the 12 volt dc Power Input module (PM-12) provide switched power for external devices, such as radios. AUX_{SW}+ is current-limited for protection of the power input and the external device via a 0.5 Amp nominal Positive Temperature Coefficient (PTC). The AUX_{SW}+ and AUX_{SW}– terminals provide voltages from 0 to 14.25 Volts dc. AUX_{SW}+ turns off when the voltage at the BAT terminals falls to a software-configurable voltage (LoLo Alarm). All module terminal blocks accept 12 to 22 AWG wiring. Refer to *Figure 3-1*.

If the source voltage falls to a level below which reliable operation cannot be ensured, the hardware circuitry on the PM-12 module automatically disables the AUX_{SW}+ outputs. This activity is based on the LoLo Alarm limit (which defaults to 10.6 Volts dc) set for the System Battery Analog Input Point Number 1. The low input voltage detect circuit includes approximately 0.75 Volts dc of hysteresis between turn-off and turn-on levels.

PM-30

The AUX_{SW}+ and AUX_{SW}–terminals on the PM-30 (11-30 Volts dc) Power Input module provides switched power for external devices, such as radios. AUX_{SW}+ is current-limited for protection of the power input and the external device via a .800 mA +/- 10% Positive Temperature Coefficient (PTC). The AUX_{SW}+ and AUX_{SW}– terminals on the PM-30 module provide voltages from 10.3 to 29.3 Volts dc which follow the input voltage. AUX_{SW}+ turns off when the voltage at the BAT terminals falls to a software-configurable voltage (LoLo Alarm). All module terminal blocks accept 12 to 22 AWG wiring. Refer to *Figure 3-3.*

If the source voltage falls to a level below which reliable operation cannot be ensured, the hardware circuitry on the Power Input module automatically disables the AUX_{SW}+ outputs. This activity is based on the LoLo Alarm limit (which defaults to 10.1 Volts dc) set for the System Battery Analog Input Point Number 1. The low input voltage

detect circuit includes approximately 0.75 Volts dc of hysteresis between turn-off and turn-on levels.

For further information on the STATUS LED functions, refer to *Table 2-2* in *Chapter 2, Installation and Use*.

3.2 Determining Power Consumption

Determining the power consumption requirements for a ROC800 configuration involves the following steps:

1. Determine your ideal ROC800 configuration, which includes identifying all modules, device relays, meters, solenoids, radios, transmitters, and other devices that may receive DC power from the complete ROC800 configuration (base unit and EXPs).

   Note: You should also identify any devices (such as a touch screen panel) that may be powered by the same system but not necessarily by the ROC800.

2. Calculate the "worst-case" DC power consumption for that configuration by totaling the combined power draw required for **all** installed modules, as well as accounting for the power any modules provide to external devices (through the use of +T).

   Note: "+T" describes the isolated power some modules (such as AI, AO, PI, and HART) may supply to external devices, such as 4–20 mA pressure and temperature transducers.

3. Verify that the power input module you intend to use can meet the power requirements calculated in the first step.

   This verification helps you identify and anticipate power demands from +T external devices that exceed the capabilities of the PM-12 or PM-24 Power Input modules. In this case, you can then make arrangements to externally power these field devices.

4. "Tune" (if necessary) the configuration by providing external power or re-assessing the configuration to lessen the power requirements from the ROC800.

To assist you in this process, this chapter contains a series of worksheets (*Tables 3-5* through *3-18*) that help you to identify and assess the power requirements for each component of your ROC800 system. *Table 3-5* identifies the power requirements related to the ROC800 and summarizes the power requirements you identify on *Tables 3-6* through *3-18*. (Complete *Tables 3-6* through *3-17* to calculate the power consumption for each of the I/O modules, and then transfer those results to *Table 3-5*.) Completing *Table 3-5* enables you to quickly determine whether the power input module you intend to use is sufficient for your configuration. If the power module is not sufficient, you can then review

individual worksheets to determine how to best "tune" your configuration and lessen power demands.

General Calculation Process

To calculate the power requirements of a ROC800 configuration requires:

1. Determine the kind and number of communication modules and the kind and number of expanded backplanes you are implementing. Enter those values in the Quantity Used column of *Table 3-5*.
2. Multiply the $P_{Typical}$ value by the Quantity Used. Enter the values in the Sub-Total column of *Table 3-5*. Perform this calculation for **both** the communications module and the LED.
3. Determine the kind and number of I/O modules you are implementing and complete *Tables 3-6* through *3-20* for those modules. For each applicable I/O module:
   a. Calculate the $P_{Typical}$ values and enter them in the $P_{Typical}$ columns of each table. Perform this calculation for the I/O modules, LEDs (if applicable), channels (if applicable), and any other devices.
   b. Calculate the Duty Cycle value for each I/O module and each I/O channel (as applicable). Enter those values in the Duty Cycle column of *Tables 3-6* through *3-20*.
   c. Multiply the $P_{Typical}$ values by the Quantity Used by the Duty Cycle on each applicable table. Enter those individual sub-totals in the Sub-Total column on each table and add the sub-totals to calculate the Total for the table.
4. Transfer the totals from *Tables 3-6* through *3-20* to their respective lines in the Sub-Total column on *Table 3-5*.
5. Add the Sub-Total values for *Tables 3-6* through *3-20*. Enter that value in the Total for All Modules line on *Table 3-5*.
6. Add the value from the Total for ROC800 Base Unit to the Total for All Modules. Enter that result in the Total for ROC800 Base Unit and All Modules line.
7. Transfer the Other Devices total from *Table 3-20* to its respective line in the Sub-Total column on *Table 3-5*.
8. Add the values from Total for ROC800 Base Unit, Total for All Modules, and the total for Other Devices. Enter that value in the Total for ROC800 Base Unit, All Modules, and Other Devices line.
9. Multiply the value in the Total for ROC800 Base Unit, Total for All Modules, and Other Devices by 0.25. Enter the result in the Power System Safety Factor (0.25) line.

Note: This value represents a safety factor to the power system to account for losses and other variables not factored into the power consumption calculations. This safety factor may vary

depending on external influences. Adjust the factor value up or down accordingly.

10. Add the value for the Power System Safety Factor (0.25) to the value for Total for ROC800 Base Unit, All Modules, and Other Devices to determine the total estimated power consumption for the configured ROC800 system.

Table 3-7. Estimated Power Consumption

Device	Power Consumption (mW)		Quantity Used	Sub-Total (mW)
	Description	$P_{TYPICAL}$		
CPU and ROC809 Backplane				
Power Input Module PM-12 (60W max)	87.5 mA @ 12 volts dc	1050 mW		
Power Input Module PM-24 (24W max)	102.1 mA @ 24 volts dc	2450 mW		
Power Input Module PM-30 (70W max)	115 mA @ 11 volts dc	1265 mW		
Power Input Module PM-30 (80W max)	102 mA @ 30volts dc	3060 mW		
Per Active LED – Maximum 13	1.5 mA	18 mW		
CPU and ROC827 Backplane				
Power Input Module PM-12	104.2 mA @ 12 volts dc	1250 mW		
Power Input Module PM-24	110.4 mA @ 24 volts dc	2650 mW		
Power Input Module PM-30 (70W max)	99 mA @ 11 volts dc	1089 mW		
Power Input Module PM-30 (80W max)	90 mA @ 30 volts dc	2700 mW		
Per Active LED – Maximum 13	1.5 mA	18 mW		
EIA-232 (RS-232) Module	4 mA @ 12 volts dc	48 mW		
Per Active LED – Maximum 4	1.5 mA	18 mW		
EIA-422/485 (RS-422/485) Module	112 mA @ 12 volts	1344 mW		
Per Active LED – Maximum 2	1.5 mA	18 mW		
Dial-up Modem Module	95 mA @ 12 volts dc	1140 mW		
Per Active LED – Maximum 4	1.5 mA	18 mW		
Expanded Backplane (ROC827 only)	25 mA @ 12 volts dc	300 mW		
			Total for ROC800 Base Unit	**mW**
AI Modules			Total (from Table 3-8)	
AO Modules			Total (from Table 3-9)	
DI Modules			Total (from Table 3-10)	
DO Modules			Total (from Table 3-11)	
DOR Modules			Total (from Table 3-12)	
PI Modules			Total (from Table 3-13)	
MVS Module			Total (from Table 3-14)	
MVS I/O Module			Total (from Table 3-15)	
APM Modules			Total (from Table 3-16)	
RTD Modules			Total (from Table 3-17)	
Thermocouple Modules			Total (from Table 3-18)	
HART-2 Modules			Total (from Table 3-19)	
IEC 62591			Total (from Table 3-20)	
NRM			Total (from Table 3-21)	
			Total for All Modules	**mW**
			Total for ROC800 Base Unit and All Modules	**mW**
Other Devices			Total (from Table 3-22)	**mW**
			Total for ROC800 Base Unit, All Modules, and Other Devices	**mW**
			Power System Safety Factor (0.25)	**mW**
			Total for Configured ROC800	**mW**

3.2.1 Tuning the Configuration

The PM-12 Power Input module can supply a maximum of 60 W (60,000 mW) to the backplane. The PM-24, when operating between –40°C to 55°C, can supply a maximum of 30 W (30000 mW) to the backplane. Across its entire operating range (–40°C to 85°C) the PM-24 can supply 24 W (24000 mW). The PM-30 Power Input module can supply a maximum of 70 W(at 11 volts dc) (70,000 mW) to 80W(at 30 volts dc) (80,000mW) at -40°C to 75°C to the backplane.

Refer to *Table 3-5* and the value you entered in the Total for ROC800 Base Unit and All Modules line. That is the value against which you "tune" your configuration to accommodate your Power Input module. If your configuration requires more power than the Power Input module you intend to use, you need to modify your I/O module configuration to reduce your power requirements.

Tuning Hints

Review the content of *Tables 3-6* through *3-20*. Suggestions to help you better align the configuration of your ROC800 with the capability of the Power Input module you intend to use include:

- Reduce the +T usage by providing an external power supply for as many transmitters or field devices needed to reduce the value in the Total for ROC800 Base Unit and All Modules line on *Table 3-5* to below the capability of the Power Input module you intend to use.
- Reduce the +T usage by reducing the number of transmitters or field devices.
- Reduce the total number of I/O modules by consolidating transmitters or field devices onto as few I/O modules as possible.

Note: Tuning your I/O module configuration may require several iterations to rework the content of *Tables 3-6 through 3-18* until your power requirements match the capability of the Power Input module you intend to use.

Table 3-8. Power Consumption of the Analog Input Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
Analog Input					
AI Module Base	84 mA @ 12 volts dc	1008 mW			
Jumper set for +T @ 12 volts dc					
Channel 1	Channel's mA current draw from +T * 1.25 * 12				
Channel 2	Channel's mA current draw from +T * 1.25 * 12				
Channel 3	Channel's mA current draw from +T * 1.25 * 12				
Channel 4	Channel's mA current draw from +T * 1.25 * 12				
Jumper set for +T @ 24 volts dc					
Channel 1	Channel's mA current draw from +T * 2.50 * 12				
Channel 2	Channel's mA current draw from +T * 2.50 * 12				
Channel 3	Channel's mA current draw from +T * 2.50 * 12				
Channel 4	Channel's mA current draw from +T * 2.50 * 12				
				Table Total	

Duty Cycle The duty cycle is based on the average current flow compared to the full-scale current flow value. To approximate the duty cycle, estimate the average current consumption in relation to its maximum range. For example, if an AI channel's current averages 16 mA:

Duty Cycle = Average mA output ÷ Maximum mA Output = (16 ÷ 20) = 0.80

Table 3-9. Power Consumption of the Analog Output Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
AO Module Base	100 mA @ 12 volts dc	1200 mW			
Jumper set for +T @ 12 volts dc					
Channel 1	Channel's mA current draw from +T * 1.25 * 12				
Channel 2	Channel's mA current draw from +T * 1.25 * 12				
Channel 3	Channel's mA current draw from +T * 1.25 * 12				
Channel 4	Channel's mA current draw from +T * 1.25 * 12				
Jumper set for +T @ 24 volts dc					
Channel 1	Channel's mA current draw from +T * 2.50 * 12				
Channel 2	Channel's mA current draw from +T * 2.50 * 12				
Channel 3	Channel's mA current draw from +T * 2.50 * 12				
Channel 4	Channel's mA current draw from +T * 2.50 * 12				
				Table Total	

Duty Cycle The duty cycle is based on the average current flow compared to the full-scale current flow value. To approximate the duty cycle, estimate the average current consumption in relation to its maximum range. For example, if an AO channel's current averages 12 mA:

Duty Cycle = Average mA output ÷ Maximum mA Output = (12 ÷ 20) = 0.60

Table 3-10. Power Consumption of the Discrete Input Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
DI Module Base	19 mA @ 12 volts dc No Channels Active	228 mW			
Channel 1	3.2 mA @ 12 volts dc	38.4 mW			
Channel 2	3.2 mA @ 12 volts dc	38.4 mW			
Channel 3	3.2 mA @ 12 volts dc	38.4 mW			
Channel 4	3.2 mA @ 12 volts dc	38.4 mW			
Channel 5	3.2 mA @ 12 volts dc	38.4 mW			
Channel 6	3.2 mA @ 12 volts dc	38.4 mW			
Channel 7	3.2 mA @ 12 volts dc	38.4 mW			
Channel 8	3.2 mA @ 12 volts dc	38.4 mW			
Per Active LED – Maximum 8	1.5 mA	18 mW			
				Table Total	

Duty Cycle The duty cycle is the time on divided by the total time, and is essentially the percent of time that the I/O channel is active (maximum power consumption).

Duty Cycle = Active time ÷ (Active time + Inactive time)

For example, if a Discrete Input is active for 15 seconds out of every 60 seconds:

Duty Cycle = 15 seconds ÷ (15 seconds + 45 seconds) = 15 seconds ÷ 60 seconds = 0.25

Table 3-11. Power Consumption of the Discrete Output Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
DO Module	20 mA @ 12 volts dc No Channels Active	240 mW			
Channel 1	1.5 mA	18 mW			
Channel 2	1.5 mA	18 mW			
Channel 3	1.5 mA	18 mW			
Channel 4	1.5 mA	18 mW			
Channel 5	1.5 mA	18 mW			
Per Active LED – Maximum 5	1.5 mA	18 mW			
				Table Total	

Duty Cycle The duty cycle is the time on divided by the total time, and is essentially the percent of time that the I/O channel is active (maximum power consumption).

Duty Cycle = Active time ÷ (Active time + Inactive time)

For example, if a Discrete Output is active for 15 seconds out of every 60 seconds:

Duty Cycle = 15 seconds ÷ (15 seconds + 45 seconds) = 15 seconds ÷ 60 seconds = 0.25

Table 3-12. Power Consumption of the Discrete Output Relay Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
DOR Module	6.8 mA @ 12 volts dc No Channels Active	81.6 mW			
Channel 1	150 mA for 10 mSec during transition	1800 mW for 10 mSec			
Channel 2	150 mA for 10 mSec during transition	1800 mW for 10 mSec			
Channel 3	150 mA for 10 mSec during transition	1800 mW for 10 mSec			
Channel 4	150 mA for 10 mSec during transition	1800 mW for 10 mSec			
Channel 5	150 mA for 10 mSec during transition	1800 mW for 10 mSec			
Per Active LED – Maximum 5	1.5 mA	18 mW for 10 mSec			
				Table Total	

Duty Cycle The duty cycle is:

[((Number of Transitions in some time period) * 0.01 sec)] ÷ (Seconds in the period) = Duty Cycle

For example, if a DOR channel changes state 80 times per hour:

- 80 = Number of transitions.
- Hour is the time period.
- An hour contains 3600 seconds.

Calculate the duty cycle as:

Duty Cycle = [(80 * 0.01) ÷ 3600] = 0.0002

Table 3-13. Power Consumption of the High and Low Speed Pulse Input Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
PI Module	21 mA @ 12 volts dc No Channels Active	252 mW			
Channel 1	7.4 mA	88.8 mW			
Channel 2	7.4 mA	88.8 mW			
Per Active LED – Maximum 4	1.5 mA	18 mW			
Jumper set to +T @ 12 volts dc	1.25 * Measured Current Draw at +T Terminal				
Jumper set to +T @ 24 volts dc	2.5 * Measured Current Draw at +T Terminal				
				Table Total	

Duty Cycle The duty cycle is the time on divided by the total time, and is essentially the percent of time that the I/O channel is active (maximum power consumption).

Duty Cycle = [Active Time * (Signals Duty Cycle)] ÷ (Total Time Period)

For example, if a Pulse Input receives a signal for 6 hours over a 24-hour time period and the signal's wave form is on time for 1/3 of the signal's period:

Duty Cycle = [6 hours * (1 ÷ 3)] ÷ (24 hours) = 0.0825

Table 3-14. Power Consumption of the MVS Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
MVS Module	112 mA @ 12 volts dc	1344 mW			
Per Active LED – Maximum 2	1.5 mA	18 mW			
Power provided by the module for the MVS sensors	1.25 * Measured Current Draw at + Terminal			1	
				Table Total	

Note: For an MVS sensor, the typical mW per MVS is about 300 mW.

Duty Cycle The duty cycle is the time on divided by the total time. For an MVS, the sensor is always drawing power, so enter the duty cycle as "1" for the MVS power calculations. The LEDs can also have an associated duty cycle, which is essentially the percent of time that the LEDs are active.

Duty Cycle = Active time ÷ (Active time + Inactive time)

For example, if the LEDs are on approximately 20 minutes a day:

Duty Cycle = 20 minutes ÷ (24 * 60 minutes in a day) = 20 ÷ 1440 = 0.014

Table 3-15. Power Consumption of the MVS I/O Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
MVS Module	27 mA @ 12 volts dc	325 mW	0 ,1, 2	1	
Power provided by the module for the MVS sensors		300 mW	1 – 12	1	
				Table Total	

Note: For an MVS sensor, the typical mW per MVS is about 300 mW.

Table 3-16. Power Consumption of the APM Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
APM Module	110 mA @ 12 volts dc	1300 mW		1	
Power provided by the module's +T port	1.25 * Measured Current Draw (from +T port in mA) * 24			1	
				Table Total	

Table 3-17. Power Consumption of the RTD Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
RTD Module	65 mA @ 13.25 volts dc			1	
				Table Total	

Duty Cycle An RTD has **no** associated duty cycle. Consequently, always set "1" as the duty cycle value.

Table 3-18. Power Consumption of the Thermocouple Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
Thermocouple Module	84 mA @ 12 volts dc	1008 mW		1	
				Table Total	

Note: The Series 1 CPU does **not** support the TC2 module.

Duty Cycle A thermocouple has **no** associated duty cycle. Consequently, always set "1" as the duty cycle value.

Table 3-19. Power Consumption of the HART-2 Module

Other Device	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
HART-2 Module Base	110 mA @ 12 volts dc	1320 mW			
Each Channel	Channel's mA current draw from +T * 2.50 * 12				
				Table Total	

Table 3-20. Power Consumption of the IEC 62591 Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
IEC 62591 Module				1	
	Pm-12 (12V) WiHart card only	552 mW		1	
	Pm-24 (24V) WiHart card only	720 mW		1	
	Pm-12 (12V) WiHart w/ Transmitter	1080 mW		1	
	Pm-24 (24V) WiHart w/ Transmitter	1200 mW		1	
				Table Total	

Duty Cycle An IEC 62591 has **no** associated duty cycle. Consequently, always set "1" as the duty cycle value.

Table 3-21. Power Consumption of the NRM Module

I/O Module	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
NRM Module				1	
	Pm-12 (12V) Joining Network	780 mW		1	
	Pm-24 (24V) Joining Network	720 mW		1	
	Pm-12 (12V) linked to Network	240 mW		1	
	Pm-24 (24V) linked to Network	240 mW		1	
				Table Total	

Duty Cycle An NRM has **no** associated duty cycle. Consequently, always set "1" as the duty cycle value.

Table 3-22. Power Consumption of Other Devices

Other Device	Power Consumption (mW)		Quantity Used	Duty Cycle	Sub-Total (mW)
	Description	$P_{TYPICAL}$			
				Total	

Although *Table 3-5* and *Tables 3-6* through *3-20* take into account the power the ROC800 supplies to its connected devices, be sure to add the power consumption (in mW) of any other devices (such as radios or solenoids) used with the ROC800 in the same power system, but which are not accounted for in *Tables 3-6* through *3-18*.

Enter that Total value in the Other Devices line of *Table 3-5*.

3.3 Removing a Power Input Module

To remove the Power Input module:

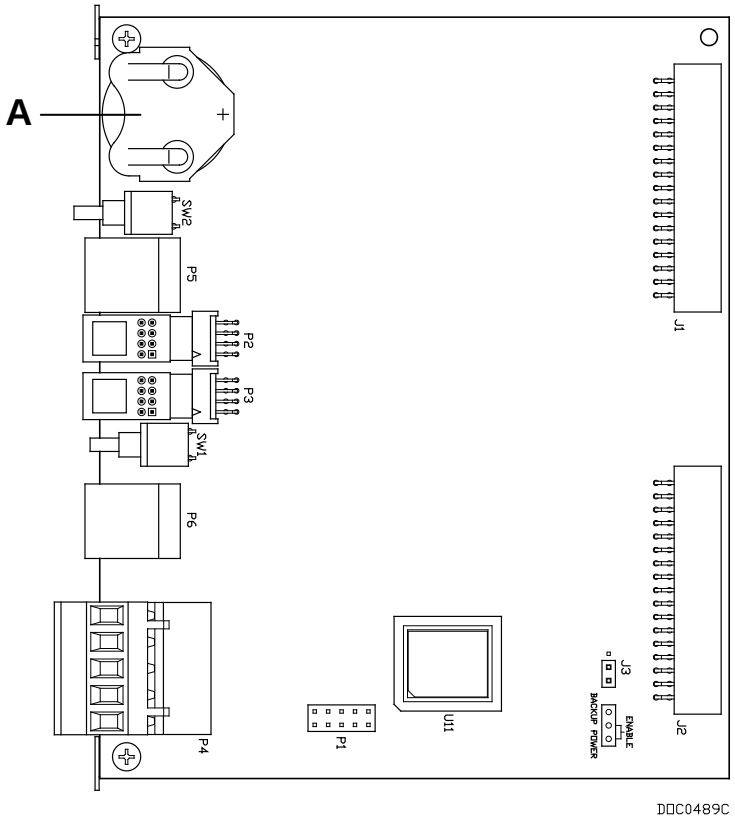
⚠ Caution

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

1. Perform the backup procedure described in *Preserving Configuration and Log Data* in *Chapter 6, Troubleshooting*.
2. Remove the wire channel cover.
3. Remove power from the ROC800.
4. Unscrew the two captive screws on the front of the Power Input module.
5. Remove the Power Input module.

Note: If you intend to store the ROC800 for an extended period, also remove the internal backup battery located on the CPU module (see *Figure 3-9* or *Figure 3-10*).



A Battery

Figure 3-9. Backup Battery on Series 2 CPU Module

3.4 Installing a Power Input Module

To install the Power Input module:

⚠ Caution

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

Note: Remove the plastic module cover and wire channel cover, if present.

1. Slide the Power Input module into the slot.
2. Press the module firmly into the slot. Make sure the connectors at the back of the Power Input module fit into the connectors on the backplane.
3. Tighten the two captive screws on the front of the Power Input module firmly (refer to *Figures 3-1* and *3-2*).

4. Return power to the ROC800.
5. Replace the wire channel cover.
6. Review *Restarting the ROC800* in *Chapter 6, Troubleshooting*.

3.5 Connecting the ROC800 to Wiring

The following paragraphs describe how to connect the ROC800 to power. Use the recommendations and procedures described in the following paragraphs to avoid damage to equipment.

Use 12 to 22 American Wire Gauge (AWG) wire for all power wiring.

⚠ Caution

Always turn off the power to the ROC800 before you attempt any type of wiring. Wiring of powered equipment could result in personal injury or property damage.

To avoid circuit damage when working with the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

To connect the wire to the removable block compression terminals:

1. Bare the end (¼ inch maximum) of the wire.
2. Insert the bared end into the clamp beneath the termination screw.
3. Tighten the screw.

The ROC800 should have a minimum of bare wire exposed to prevent short circuits. Allow some slack when making connections to prevent strain.

3.5.1 Wiring the DC Power Input Module

Use 12 to 22 American Wire Gauge (AWG) wire for all power wiring. It is important to use good wiring practice when sizing, routing, and connecting power wiring. All wiring must conform to state, local, and NEC codes. Verify that the hook-up polarity is correct.

To make DC power supply connections:

1. Install a surge protection device at the service disconnect.
2. Remove all other power sources from the ROC800.
3. Install a fuse at the input power source (see *Figure 3-5*).
4. Remove the terminal block connector from the socket.
5. Insert each bared wire end into the appropriate power module connectors:
   - **For PM-12** (12 Volts dc source): into the clamp beneath the appropriate BAT+ and BAT– termination screws.

- **For PM-24** (24 Volts dc source): into the clamp beneath the appropriate POWER INPUT+ and POWER INPUT– termination screws.
- **For PM-30** (30 Volts dc source): into the clamp beneath the appropriate POWER INPUT+ and POWER INPUT– termination screws.

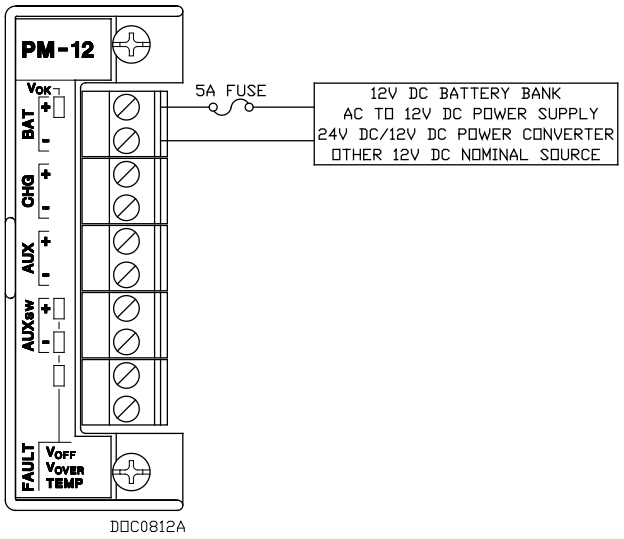


Figure 3-11. 12 Volts dc Power Supply and BAT+ / BAT- Wiring

6. Screw each wire into the terminal block.
7. Plug the terminal block connector back into the socket.
8. If you are monitoring an external charge voltage (12 Volts dc Power Input Module only), wire the CHG+ and CHG– terminal block connector. Refer to *Figure 3-12*.

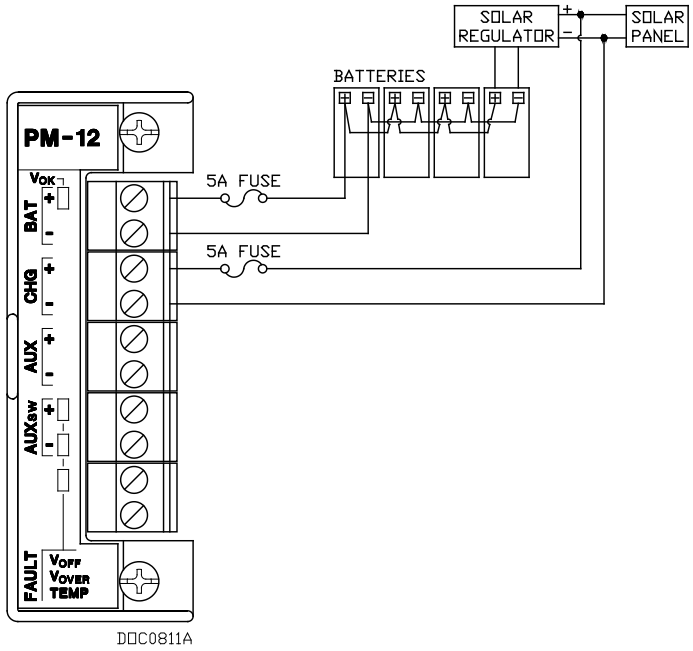


Figure 3-12. 12 Volt dc Power Supply and CHG+ / CHG– Wiring

9. Replace all other power sources (if necessary) to the ROC800.

10. Review *Restarting the ROC800* in *Chapter 6, Troubleshooting*.

Note: Refer to *Table 3-2* concerning LEDs.

3.5.2 Wiring the External Batteries

You can use external batteries as the main source of power for the ROC800 with the 12 volts dc Power Input module (PM-12). The maximum voltage that can be applied to the BAT+ / BAT– terminals is 16 volts dc before damage may occur. The recommended maximum voltage is 14.5 volts dc (refer to *Table 3-2* concerning LEDs).

It is important that you use good wiring practices when sizing, routing, and connecting power wiring. All wiring must conform to state, local, and NEC codes. Use 12 to 22 American Wire Gauge (AWG) wire for all power wiring.

Batteries should be rechargeable, sealed, gel-cell, lead-acid batteries.

Connect batteries in parallel to achieve the required capacity (refer to *Figure 3-6*). The amount of battery capacity required for a particular installation depends upon the power requirements of the equipment and days of reserve (autonomy) desired. Calculate battery requirements based on power consumption of the ROC800 and all devices powered by the batteries.

Battery Reserve

Battery reserve is the amount of time that the batteries can provide power without discharging below 20% of their total output capacity. The battery reserve should be a minimum of five days, with ten days of reserve preferred. Add 24 hours of reserve capacity to allow for overnight discharge. Space limitations, cost, and output are all factors that determine the actual amount of battery capacity available.

To determine the system capacity requirements, multiply the system current load on the batteries by the amount of reserve time required, as shown in the following equation:

System Requirement = Current Load in Amps * Reserve Hours = _____ Amp Hours

⚠ Caution **When using batteries, apply in-line fusing to avoid damaging the ROC800.**

To make battery connections:

1. Perform the backup procedure described in *Preserving Configuration and Log Data* in *Chapter 6, Troubleshooting*.
2. Remove the BAT+ and BAT– terminal block connector from the socket.
3. Install a fuse at the input power source.
4. Insert each bared wire end into the clamp beneath the BAT+ and BAT– termination screws (refer to *Figure 3-5*).
5. Screw each wire into the terminal block.
6. Review *Restarting the ROC800* in *Chapter 6, Troubleshooting*.
7. Re-apply power to the ROC800.

Note: Refer to *Table 3-2* concerning LEDs.

3.5.3 Replacing the Internal Battery

The internal Sanyo 3 volt CR2430 lithium backup battery located on the CPU provides backup of the data and the Real-Time Clock when the main power is not connected. The battery has a one-year minimum backup life while the battery is installed and no power is applied to the ROC800. The battery has a ten-year backup life while the backup battery is installed and power is applied to ROC800 or when the battery is removed from the ROC800.

Recommended replacement lithium/manganese dioxide batteries include:

Table 3-23. Replacement Battery Types

Part	Battery, Lithium, 3V
Size	24 mm (0.94 in) diameter x 3 mm (0.12 in) height

Type	Coin Type
Capacity	280 mAh minimum
Acceptable Types	▪ Duracell DL2430 ▪ Eveready CR2430 ▪ Sanyo CR2430 ▪ Varta CR2430

Note: Remove the internal backup battery if you intend to store the ROC800 for an extended period.

⚠ Caution

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing these procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Perform the backup procedure described in *Preserving Configuration and Log Data* in *Chapter 6, Troubleshooting*.

   Note: Removing the battery erases the contents of the ROC800's RAM.

2. Remove all power from the ROC800.
3. Remove the wire channel cover.
4. Remove the two screws on the CPU faceplate.
5. Remove the CPU faceplate.
6. Remove the CPU (as described in *Removing the CPU Module* in *Chapter 2, Installation and Use*).
7. Insert a plastic screwdriver behind the battery and gently push the battery out of the battery holder. **Note how the battery is oriented**: the negative side of the battery (–) is placed against the CPU and the positive (+) towards the + label on the battery holder.
8. Insert the new battery in the battery holder paying close attention to install the battery with the correct orientation.
9. Reinstall the CPU (as described in *Installing the CPU Module* in *Chapter 2, Installation and Use*).
10. Replace the CPU faceplate.
11. Replace the two screws to secure the CPU faceplate.
12. Replace the wire channel cover.
13. Review *Restarting the ROC800* in *Chapter 6, Troubleshooting*.
14. Apply power to the ROC800.

3.6 Additional Technical Information

Refer to the following technical documentation (available at *www.EmersonProcess.com/Remote*) for additional and most-current information.

Table 3-24. Power Input Modules Technical Specifications

Name	Form Number	Part Number
ROC800-Series Power Input Modules	ROC800:PWR	D301192X012

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Chapter 4 – Input/Output Modules

This chapter describes the Input/Output (I/O) modules used with the ROC800 and expansion backplanes and contains information on installing, wiring, and removing those modules.

In This Chapter

4.1 I/O Module Overview 4-1
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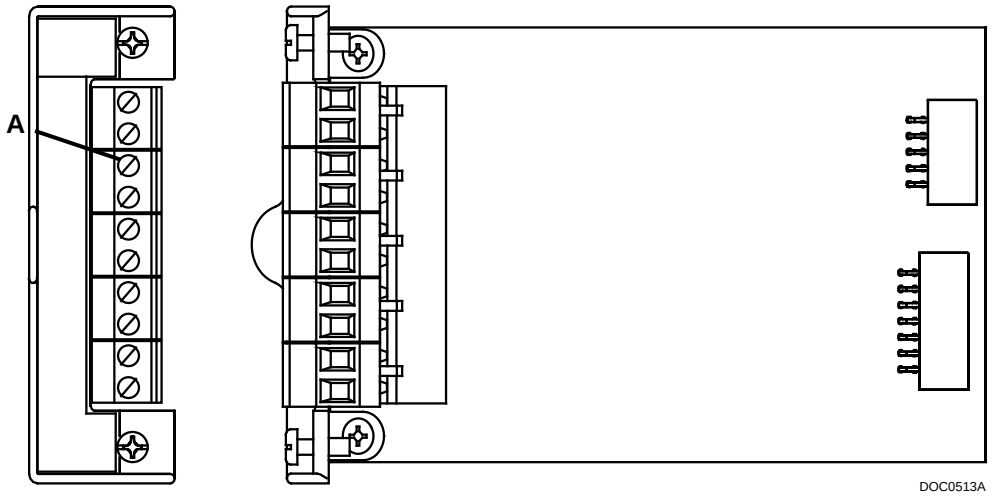
4.1 I/O Module Overview

The I/O modules typically consist of a terminal block for field wiring and connectors to the backplane. Each I/O module uses a removable terminal block to electrically connect to field wiring. Refer to *Figures 4-1* and *4-2*.

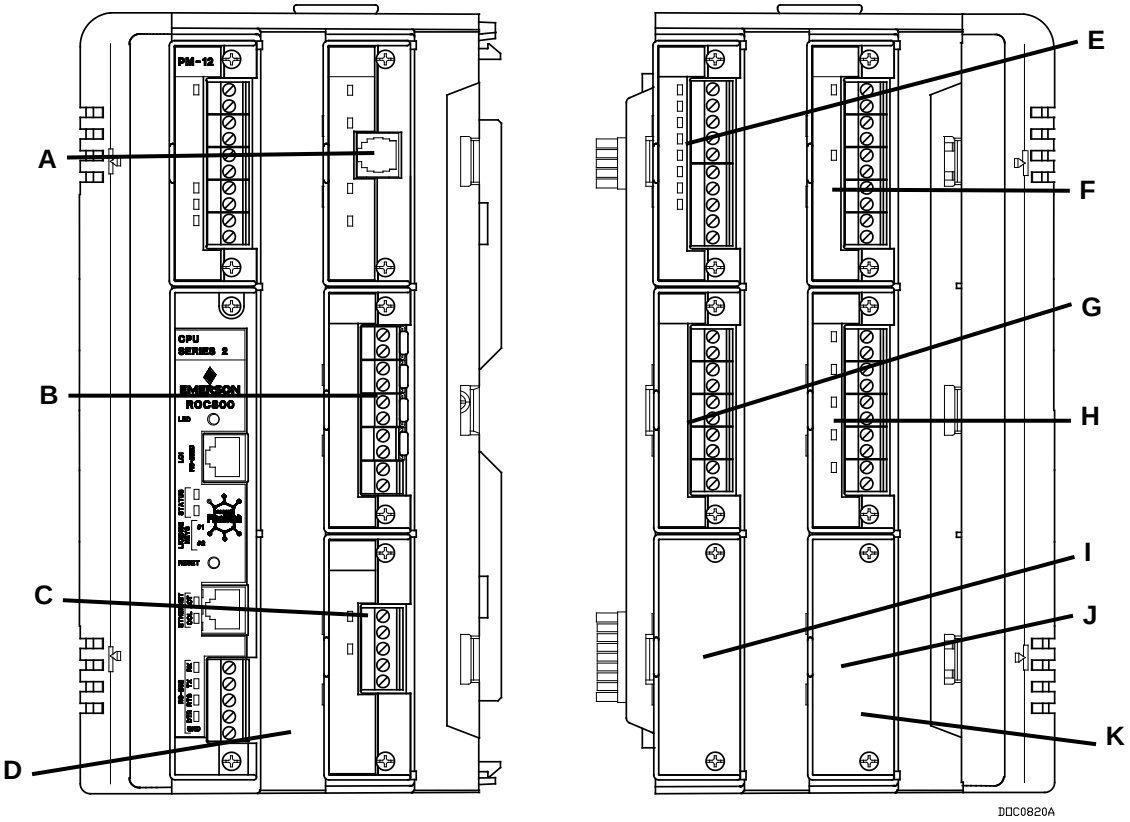
Note: *Figure 4-2* represents a ROC827 with one EXP.



Front View Side View

A Terminal Blocks

Figure 4-1. Typical I/O Module



A	I/O Slot #1 (Comm 3)	**G**	I/O Slot #5
B	I/O Slot #2 (Comm 4)	**H**	I/O Slot #8
C	I/O Slot #3 (Comm 5)	**I**	I/O Slot #6
D	Wire Channel Cover	**J**	I/O Slot #9
E	I/O Slot #4	**K**	Module Slot Cover
F	I/O Slot #7		

Figure 4-2. Optional I/O Module Locations (ROC827 with one EXP)

I/O modules for the ROC800 include:

- Analog Input (AI) modules that provide the ability to monitor various analog field values.
- Discrete Input (DI) and Pulse Input (PI) modules that provide the ability to monitor various discrete and pulse input field values.
- Analog Output (AO), Discrete Output (DO), and Discrete Output Relay (DOR) modules that provide the ability to manage various control devices.
- Advance Pulse modules (APM) that provide advanced functionality (such as densitometer support) commonly found in liquids and gas measurement applications.
- Alternating Current I/O (ACIO) modules that control various AC output field devices and monitor various AC input field values.
- Multiple Variable Sensor I/O (MVS I/O) modules that provide differential pressure, static pressure, and temperature inputs for orifice flow calculation.
- Resistance Temperature Detector (RTD) and Thermocouple (TC) modules that provide the ability to monitor various analog temperature field values.
- HART module that receives and sends I/O from HART devices via a 4-20 mA analog signal.

Each module rests in a module slot at the front of the ROC800 or EXP housing. All modules have removable terminal blocks to make servicing easy. You can insert I/O modules in any module slot; modules are self-identifying in the software.

⚠ Caution

The design of ROC800-Series communications and I/O modules supports "hot-swapping" (replacing similar modules in the same slot) and "hot-plugging" (inserting modules into an empty slot) while the ROC800 is powered. However, it is a good safety practice with any electrical device to first remove power before you make internal connections. If you find it necessary to hot-swap or hot-plug a module, first review the most current specification sheet for that module to ensure both your safety and the integrity of data that module may provide.

The I/O modules acquire power from the backplane. Each module has an isolated DC/DC converter that provides logic, control, and field power as required. The ROC800 has eliminated the need for fuses on the I/O modules through the extensive use of current-limited short-circuit protection and over voltage circuitry. Isolation is provided from other modules and the backplane, power, and signal isolation. The I/O modules are self-resetting after a fault clears.

4.2 Installation

⚠ Caution

Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.

When installing units in a hazardous area, make sure all installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous. Installation in a hazardous area could result in personal injury or property damage.

Each I/O module installs in the ROC800 in the same manner. You can install any I/O module into any module socket, whether empty or in place of another module.

⚠ Caution

The design of ROC800-Series communications and I/O modules supports "hot-swapping" (replacing similar modules in the same slot) and "hot-plugging" (inserting modules into an empty slot) while the ROC800 is powered. However, it is a good safety practice with any electrical device to first remove power before you make internal connections. If you find it necessary to hot-swap or hot-plug a module, first review the most current specification sheet for that module to ensure both your safety and the integrity of data that module may provide.

Note: After you install a new I/O module or replace an existing I/O module, it may be necessary to reconfigure the ROC800. To change configuration parameters, use ROCLINK 800 software to make changes to the new module. Any added modules (new I/O points) start up with default configurations. Refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

4.2.1 Removing and Installing Wire Channel Covers

The ROC800 includes wire channel covers (see *Figure 4-2*) you install over the wiring channels once you complete wiring the terminal blocks on the modules.

To remove a wire channel cover:

1. Grasp the wire channel cover at both the left and right ends.
2. Start at the left or right and pull the wire channel cover out of the wire channel.

To install a wire channel cover:

1. Align the wire channel cover over the wire channel, allowing unobstructed wire access.
2. Press the wire channel cover into place until it snaps.

Note: The tabs on the top side of the wire channel cover should rest in the slots on the top edge of the channel.

4.2.2 Removing and Installing Module Slot Covers

Before you insert an I/O or communications module, remove the module cover (see *Figure 4-2*) over the empty module slots in which you intend to install the modules. Although you are not required to remove the power to the ROC800 to perform this procedure, caution is always advisable when working with a powered ROC800.

⚠ Caution

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions (such as wearing a grounded wrist strap).

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To remove a module cover:

1. Remove the wire channel cover.
2. Unscrew the two captive screws on the face of the cover.
3. Using the tab at the top side of the module cover, lift the module cover from the ROC800.

Note: If you remove a module for an extended period, install a module slot cover over the empty module slot to keep dust and other matter from getting into the ROC800.

To install a module cover:

1. Place the module cover over the module slot.
2. Tighten the two captive screws on the face of the cover.
3. Replace the wire channel cover.

4.2.3 Installing an I/O Module

To install an I/O module in either the ROC800 or the EXP:

1. Remove the wire channel cover.

   Note: Leaving the wire channel cover in place can prevent the module from correctly connecting to the socket on the backplane.

2. Perform one of the following:

   - If there is a module currently in the slot, unscrew the captive screws and remove that module (refer to *Removing an I/O Module*).

- If the slot is currently empty, remove the module cover.

3. Insert the new I/O module through the module slot on the front of the ROC800 or EXP housing. Make sure the label on the front of the module faces right side up (refer to *Figure 4-3*). Gently slide the module in place until it contacts properly with the connectors on the backplane.

Note: If the module stops and will not go any further, **do not** force the module. Remove the module and see if the pins are bent. If the pins are bent, gently straighten the pins and re-insert the module. The back of the module **must** connect fully with the connectors on the backplane.

Figure 4-3. Installing an I/O Module

4. Tighten the captive screws on the front of the module.
5. Wire the I/O module (refer to *Wiring I/O Modules*).
6. Replace the wire channel cover.

⚠ Caution **Never connect the sheath surrounding shielded wiring to a signal ground terminal or to the common terminal of an I/O module. Doing so makes the I/O module susceptible to static discharge, which can permanently damage the module. Connect the shielded wiring sheath only to a suitable earth ground.**

7. Connect to ROCLINK 800 software and login. The I/O modules are self-identifying after re-connecting to ROCLINK 800 software.
8. Configure the I/O point.

4.2.4 Removing an I/O Module

To remove an I/O module:

1. Remove the wire channel cover.
2. Disconnect the field wiring.
3. Unscrew the two captive screws holding the module in place.
4. Gently pull the module's lip out and remove the module from the slot. You may need to gently wiggle the module.
5. Install a new module or install the module cover.
6. Screw the two captive screws to hold the module or cover in place.
7. Replace the wire channel cover.

4.2.5 Wiring I/O Modules

All modules have removable terminal blocks for convenient wiring and servicing. The terminal blocks can accommodate 12 to 22 AWG for wiring.

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

To connect the wire to the removable block compression terminals:

1. Bare the end (¼ inch maximum) of the wire.
2. Insert the bared end into the clamp beneath the termination screw.
3. Tighten the screw.

The ROC800 should have a minimum of bare wire exposed to prevent short circuits. Allow some slack when making connections to prevent strain.

Note: All modules have removable terminal blocks for convenient wiring and servicing. Twisted-pair cable is recommended for I/O signal wiring. The removable terminal blocks accept 12 to 22 AWG wiring.

4.3 Analog Input (AI) Modules

The Analog Input (AI) modules (both AI-12 and AI-16) have four scalable channels which typically measure either:

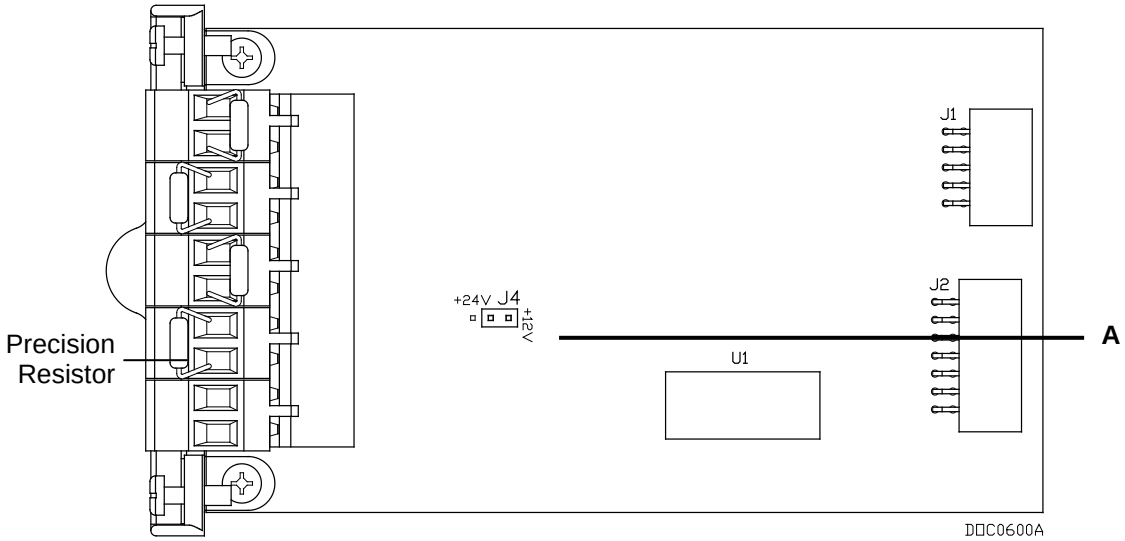
- 4–20 mA analog signal, with the use of a precision resistor (supplied).
- 1–5 Volts dc signal.

If required, you can calibrate the low end of the analog signal to zero. Refer to *Chapter 7* in the ROC800-Series specific manual (Part Number

D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

Note: The AI-16 module provides 16-bit resolution and uses a 24-bit A/D converter. DIP switches on the AI-16 module (see *Figure 4-6*) allow you to select between current and voltage loop input.

You can configure the AI (+T) module as either 12 or 24 Volt dc using jumper J4 on the AI-12 module (see *Figure 4-4*). The AI modules can provide isolated +12 Volt dc or +24 Volt dc field transmitter power on a per-module basis. For example, one module can provide +12 Volts dc for powering low power analog transmitters, while another module in the same ROC800 can provide +24 Volts dc for powering conventional 4–20-mA transmitters. Refer to *Figure 4-5*.



A 12 / 24 V dc Jumper

Figure 4-4. AI-12 Jumper J4 (Shown Set to +12V)

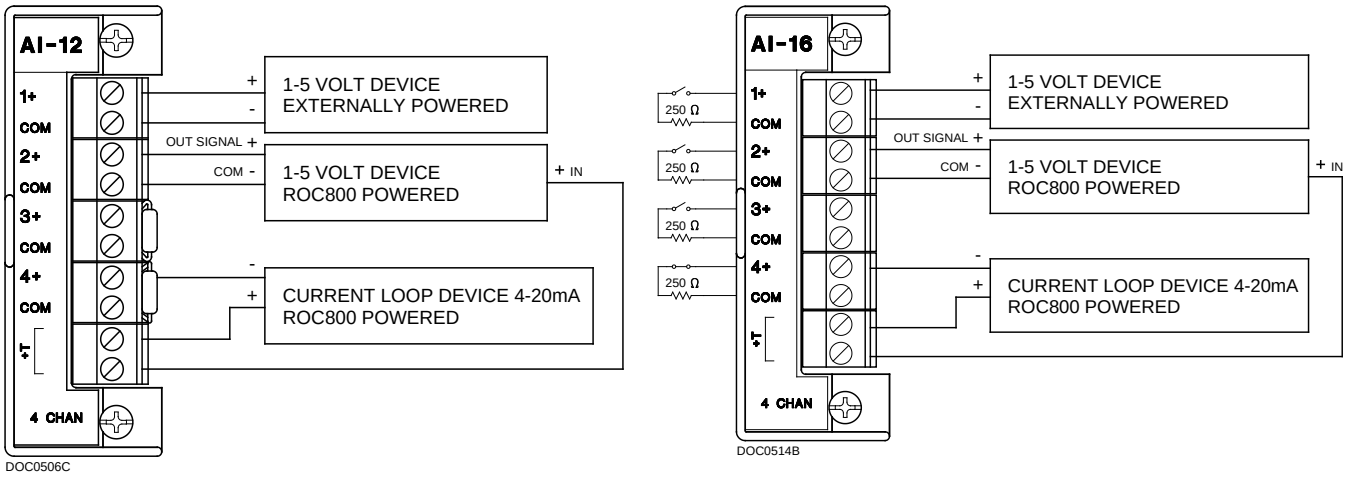
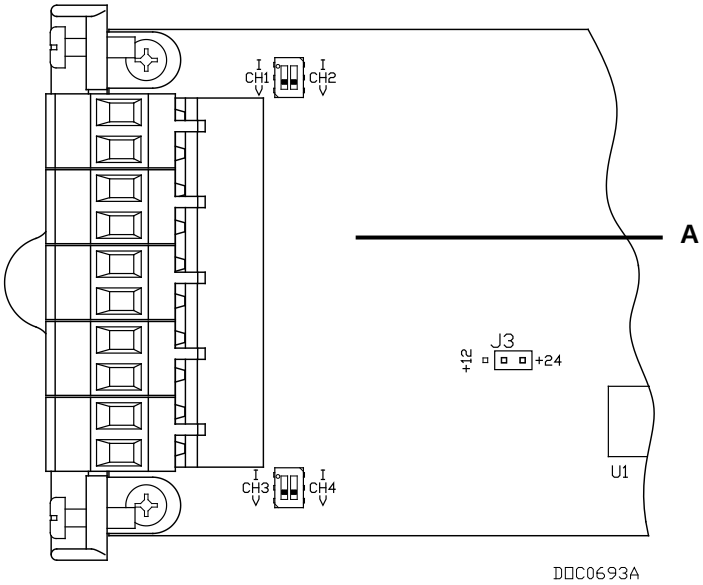


Figure 4-5. Analog Input Module Field Wiring (AI-12 and AI-16)

On the AI-16 module, you use jumper J3 to configure the AI (+T) as 12 or 24 Volts dc. Additionally, two DIP switches on the module allow you to select between current and voltage loop input.



A I indicates current loop input; V indicates voltage loop input

Figure 4-6. AI-16 DIP Switches

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

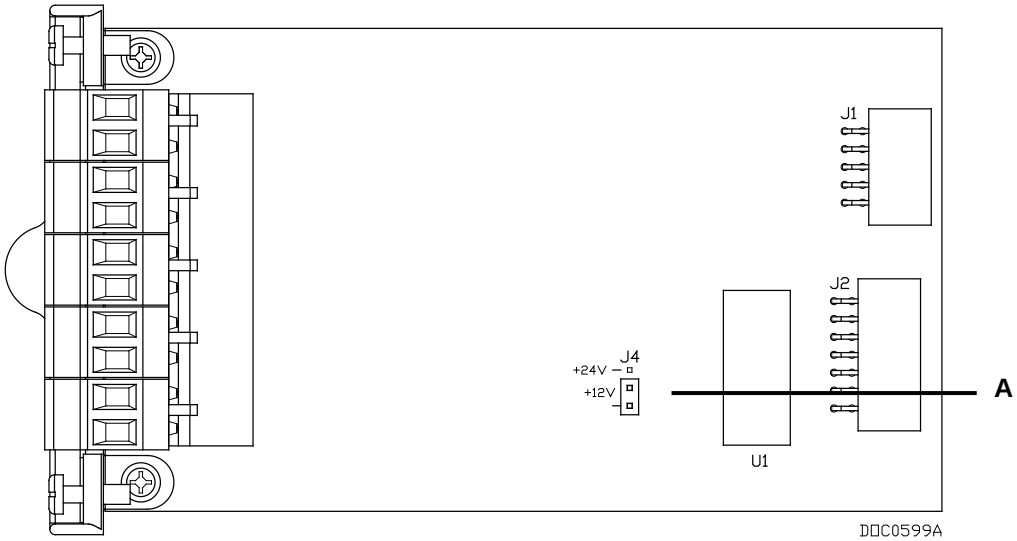
4.4 Analog Output (AO) Modules

The 16-bit Analog Output (AO) module has four channels that provide a current output for powering analog devices. Analog outputs are analog signals the ROC800 generates to regulate equipment, such as control valves or any device requiring analog control.

Each channel on this module provides a 4 to 20 mA current signal for controlling analog current loop devices. The AO module isolation includes the power supply connections.

Note: AO modules (Part Number W38199) labeled **AO-16** are an earlier version that controls the low side current. AO modules (Part Number W38269) labeled **AO** are a newer version (January 2005 and later) that provides and controls the high side current.

The AO module includes a moveable jumper (see *Figure 4-7*). Set the jumper to 12V if the transmitter load is 300Ω or less. Set the jumper to 24V if the transmitter load exceeds 300Ω.



A 12V / 24V dc Jumper

Figure 4-7. Analog Output Jumper J4 (Shown Set to +12V)

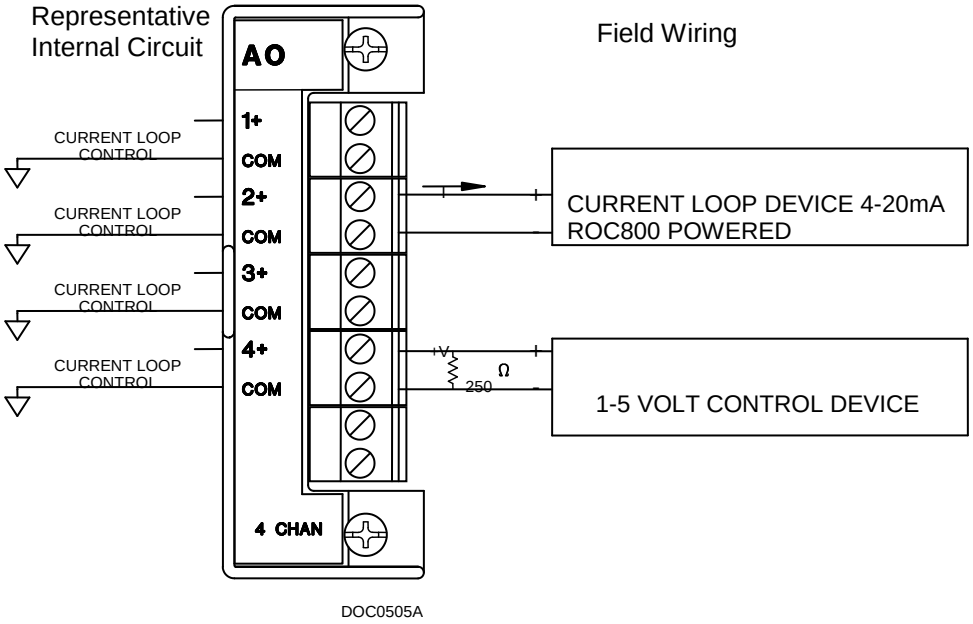


Figure 4-8. Analog Output Module Field Wiring

Caution **You can induce ground loops by tying commons from various modules together.**

4.5 Discrete Input (DI) Modules

The eight-channel Discrete Input (DI) modules monitor the status of relays, open collector/open drain type solid-state switches, and other two-state devices. Discrete Inputs come from relays, switches, and other devices, which generate an on/off, open/close, or high/low signal.

The DI module provides a source voltage for dry relay contacts or for an open-collector solid-state switch.

The DI module's LEDs light when each input is active.

Each DI channel can be software-configured to function as a momentary or latched DI (see the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)*, Part Number D301250X012 or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)*, Part Number D301246X012). A latched DI remains in the active state until reset. Other parameters can invert the field signal and gather statistical information on the number of transitions and the time accumulated in the on- or off-state.

⚠ Caution **The Discrete Input module is designed for use with "dry" relay contacts or solid-state switches. Applied voltage in excess of 24 Vdc may damage the module.**

The DI module senses the current flow, which signals the ROC800 electronics that the relay contacts have closed. The opening of the contacts interrupts the current flow and the DI module signals the ROC800 electronics that the relay contacts have opened. Using ROCLINK 800, you can set the scan rate between 4 and 43200 milliseconds.

The left side of *Figure 4-9* displays the internal circuitry while the right side displays possible field wiring.

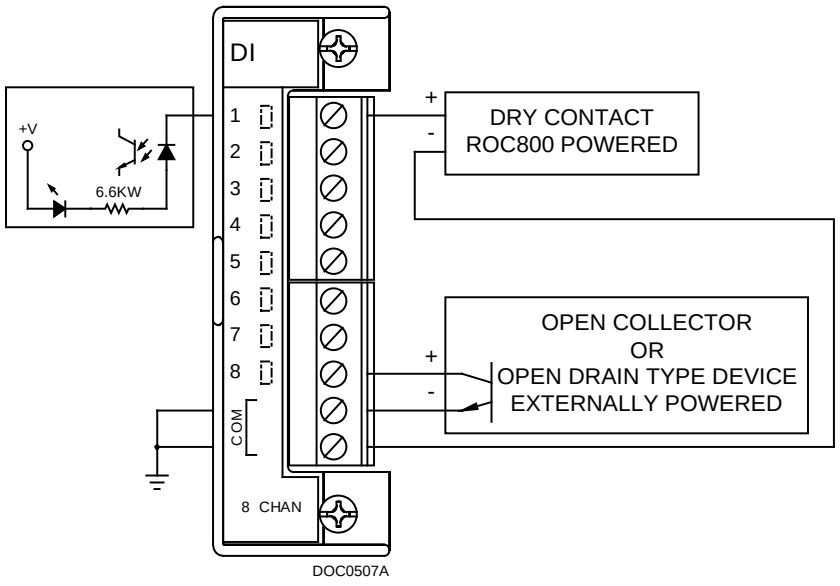


Figure 4-9. Discrete Input Module Field Wiring

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

4.6 Pulse Input (PI) Modules

The Pulse Input (PI) module provides two channels for measuring either a low speed or high speed pulse signal. The PI module processes signals from pulse-generating devices and provides a calculated rate or an accumulated total over a configured period. Supported functions are slow-counter input, slow rate input, fast counter input, and fast rate input.

The PI is most commonly used to interface to relays or open collector/open drain type solid-state devices. The Pulse Input can be used to interface to either self-powered or ROC800-powered devices.

The high speed input supports signals up to 12 kHz while the low speed input is used on signals less than 125 Hz.

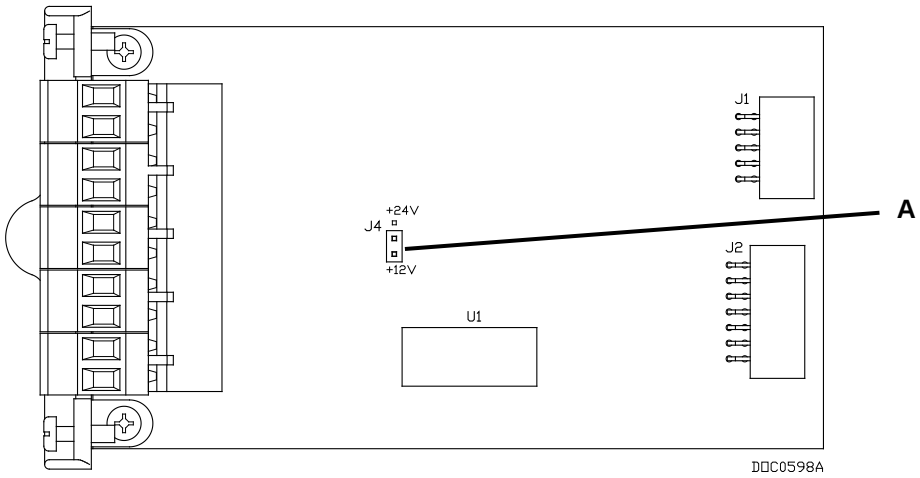
You can configure the PI module as either 12 or 24 Volts dc using jumper J4 on the I/O module (see *Figure 4-10*). The PI modules can provide isolated +12 Volt dc or +24 Volt dc field transmitter power on a per-module basis. For example, one module can provide +12 Volt dc power, while another module in the same ROC800 can provide +24 Volt dc power. Refer to *Figures 4-11* and *4-12*.

The PI module provides LEDs that light when each input is active.

⚠ Caution **The Pulse Input module is designed for use with "dry" relay contacts or solid-state switches. Applied voltage in excess of 24 Vdc may damage the module.**

The PI modules draw power for the active circuitry from the backplane. Input signals are optically isolated.

Note: Do not connect wiring to **both** the Low and High speed selections for a given channel. This results in unpredictable operation of the PI module.



A +T 12 / 24 V dc Jumper

Figure 4-10. Pulse Input J4 Jumper (Set to +12 V)

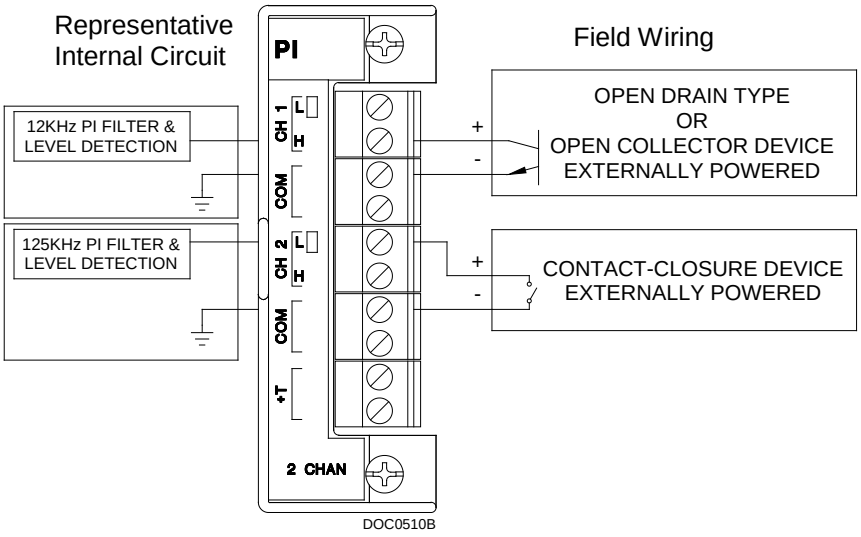


Figure 4-11. Externally Powered Pulse Input Module Field Wiring

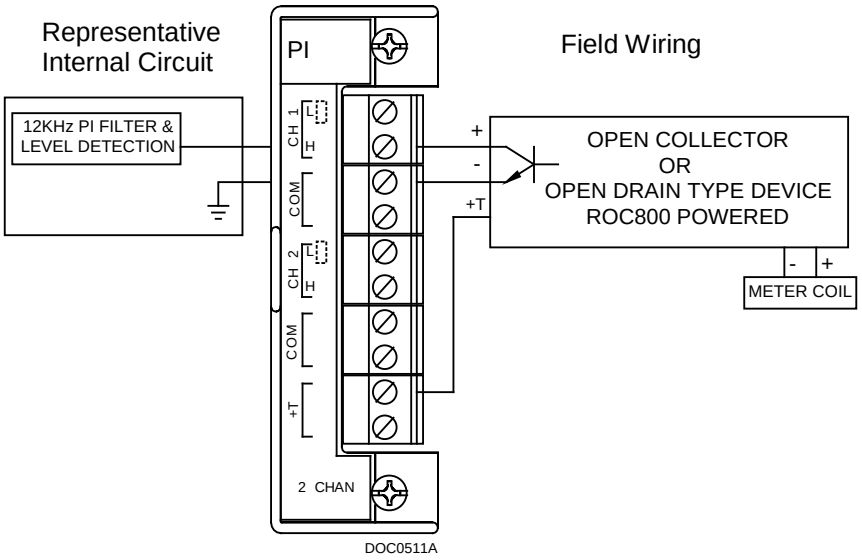


Figure 4-12. ROC800-Powered Pulse Input Module Field Wiring

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

4.7 Discrete Output (DO) Modules

The five-channel Discrete Output (DO) module provides two-state outputs to energize solid-state relays and power small electrical loads. These are solid-state relays. A Discrete Output may be set to send a pulse to a specified device. Discrete Outputs are high and low outputs used to turn equipment on and off.

DO modules can be software-configured as latched, toggled, momentary, or Timed Duration Outputs (TDO). The DO can be

configured to either retain the last value on reset or use a user-specified fail-safe value.

The DO module provides LEDs that light when each output is active.

When a request is made to change the state of a DO, the request is immediately sent to the DO module. There is no scan time associated with a DO. Under normal operating conditions, the DO channel registers the change within 2 milliseconds.

If the DO is in momentary or toggle mode, you can enter a minimum time-on of 4 milliseconds.

Figure 4-13 displays the field wiring connections to the output circuit of the DO module.

⚠ Caution **The Discrete Output module is an open-drain type output. It is not capable of sourcing current or voltage to a load. Do not directly connect a power source to the terminal block.**

DO modules draw power for the active circuitry from the backplane, and are current-limited for protection against excessive current.

Note: When using the Discrete Output module to drive an inductive load (such as a relay coil), place a suppression diode across the input terminals to the load. This protects the module from the reverse Electro-Motive Force (EMF) spike generated when the inductive load is switched off.

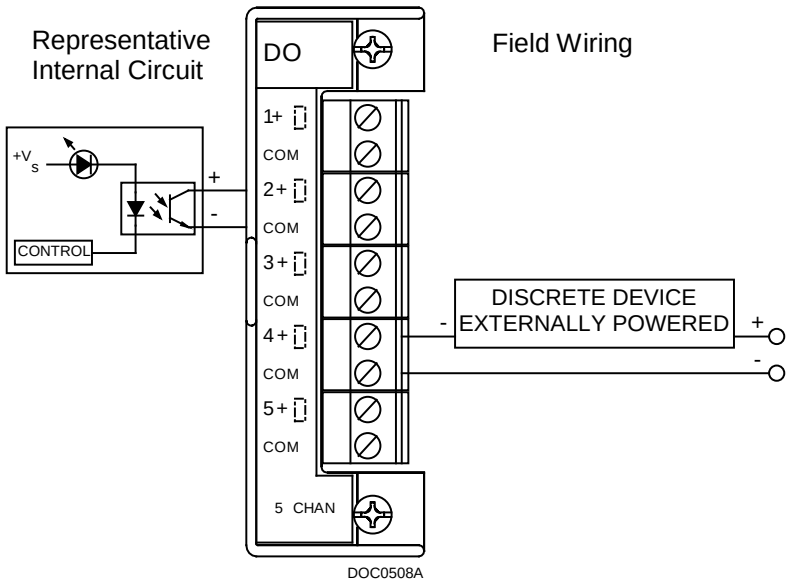


Figure 4-13. Discrete Output Module Field Wiring

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

Virtual DO ROCLINK 800 provides a "virtual DO" software setting to support fieldbus devices, which may require the toggle characteristics of DO. For further information, see the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part number D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

4.8 Discrete Output Relay (DOR) Modules

The five-channel DO Relay (DOR) module provides LEDs that light when each output is active. DOR modules use dual-state latching relays to provide a set of normally open, dry contacts capable of switching 2 A at 32 Volts dc across the complete operating temperature. Using ROCLINK 800, you can configure the module as latched, toggled, momentary, or Timed Duration Outputs (TDO). The DOR can either retain the last value on reset or use a user-specified fail-safe value.

Note: Since the DOR latches, a power failure does not change the relay's state. The relay retains the state (open or closed) it had upon failure.

Figure 4-14 displays the field wiring connections to the output circuit of the DOR module.

⚠ Caution **The Discrete Output module is designed as a "dry" relay contact. Applied voltages in excess of 32 Vdc or any AC voltage may damage the module.**

When a request is made to change the state of a DOR, the request is immediately sent to the DOR module. There is no scan time associated with a DOR. Under normal operating conditions, the DOR channel registers the change within 12 milliseconds. If the DOR is in momentary or toggle mode, DOR channels register the change within 48 milliseconds.

The DOR modules draw power for the active circuitry from the backplane.

Note: On power up or reset, the DO Relay module's LEDs enter indeterminate state for a few seconds as the module self-identifies. The LEDs may flash, stay on, or stay off for a few seconds.

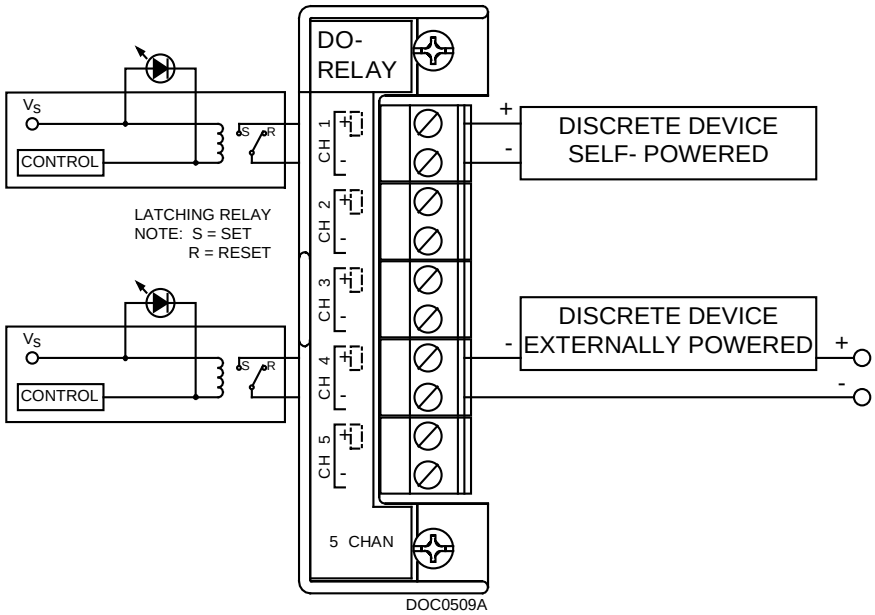


Figure 4-14. Discrete Output Relay Module Field Wiring

4.9 Resistance Temperature Detector (RTD) Input Modules

The Resistance Temperature Detector (RTD) module monitors the temperature signal from an RTD source. The module can accommodate input from a two-, three-, or four-wire RTD source.

The active element of an RTD probe is a precision, temperature-dependent resistor made from a platinum alloy. The resistor has a predictable positive temperature coefficient, meaning its resistance increases with temperature. The RTD input module works by supplying a small consistent current to the RTD probe and measuring the voltage drop across it. Based on the voltage curve of the RTD, the ROC800 firmware converts the signal to temperature.

The RTD input module monitors the temperature signal from a resistance temperature detector (RTD) sensor or probe. A two-channel 16-bit RTD module is available. The RTD module isolation includes the power supply connections.

The RTD modules draw power for the active circuitry from lines on the backplane.

It may be more convenient to perform calibration before connecting the field wiring. However, if the field wiring between the ROC800 and the RTD probe is long enough to add a significant resistance, then perform calibration in a manner that considers this.

Connecting the RTD Wiring

Temperature can be input through the Resistance Temperature Detector (RTD) probe and circuitry. An RTD temperature probe mounts directly to the piping using a thermowell. Protect RTD wires either by a metal sheath or by conduit connected to a liquid-tight conduit fitting. The RTD wires connect to the four screw terminals on

the RTD module. See *Table 4-1*, *Table 4-2*, and *Figure 4-15*.

The ROC800 provides terminations for a four-wire 100-ohm platinum RTD with a DIN 43760 curve. The RTD module supports RTDs with alphas equal to 0.00385 or 0.00392 Ω/Ω/°C. You can use a two-wire or three-wire RTD probe instead of a four-wire probe, but they may produce measurement errors due to signal loss on the wiring.

Wiring between the RTD probe and the ROC800 must be shielded wire, with the shield grounded only at one end to prevent ground loops. Ground loops cause RTD input signal errors.

Table 4-1. RTD Signal Routing

Terminal	Label	Definition
1	REF	CH1 Constant Current +
2	+	CH1 Positive RTD
3	–	CH1 Negative RTD
4	RET	CH1 Constant Current –
5	N/A	Not Used
6	REF	CH2 Constant Current +
7	+	CH2 Positive RTD
8	–	CH2 Negative RTD
9	RET	CH2 Constant Current –
10	N/A	Not Used

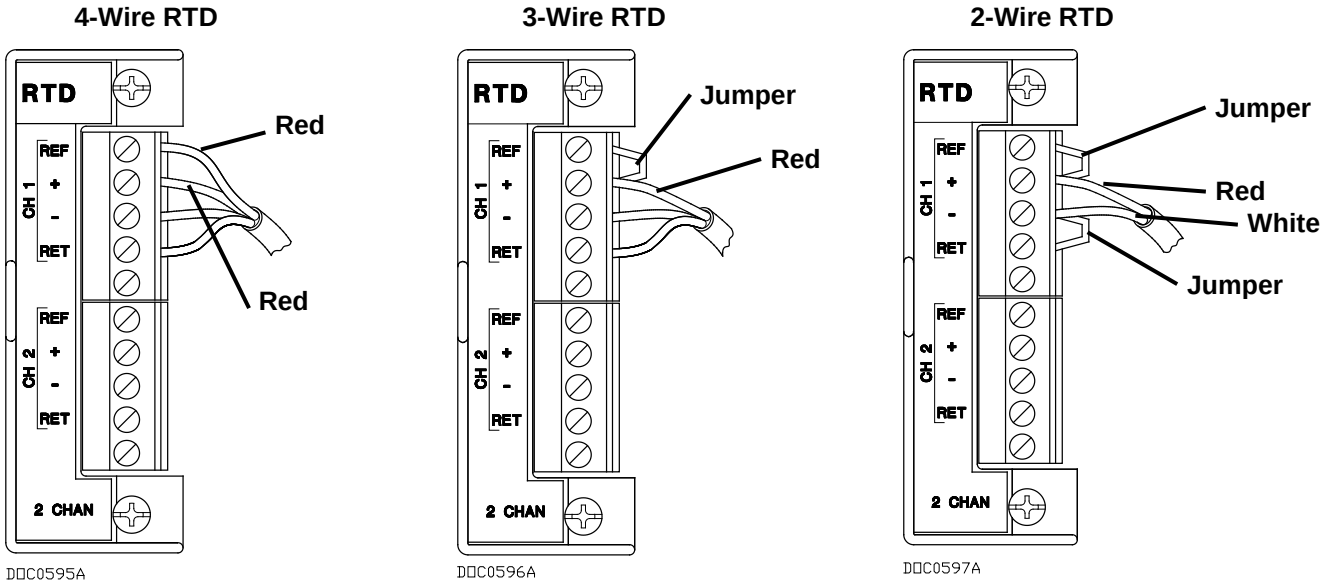


Figure 4-15. RTD Sensor Wiring Terminal Connections

Figure 4-15 and *Table 4-2* display the connections at the RTD terminals for the various RTD probes.

Table 4-2. RTD Wiring

Terminal	4-Wire RTD	3-Wire RTD	2-Wire RTD
REF	Red	Jumper to +	Jumper to +
+	Red	Red, Jumper to REF	Red, Jumper to REF
–	White	White	White, Jumper to RET
RET	White	White	Jumper to –

Note: The wire colors for the RTD being used may differ.

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

4.10 Advanced Pulse Module (APM)

The APM provides advanced functionality commonly found in liquids and gas measurement programs, including support for densitometer inputs, detector inputs, pulse inputs, pulse frequencies, pulse outputs, and proving. Field wiring (see *Figures 4-16* through *4-24*) and DIP switch settings (see *Figure 4-25* and *Table 4-3*) provide this flexibility.

Note: The ROC800 can support up to 27 APMs.

You can connect densitometer inputs to any channel. However, for current-modulated densitometers (such as the Micro Motion – formerly Solartron – 7835/7845 densitometer), you can designate channel 3 as a pulse input using a frequency input channel with hardware filtering. You can also designate channel 4 as a pulse input or a solid state pulse output.

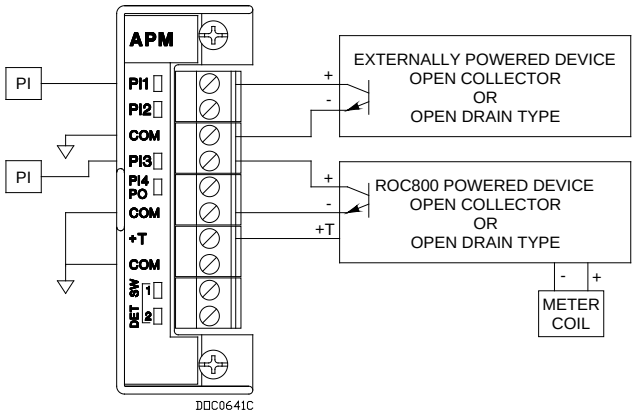


Figure 4-16. Pulse Input Wiring on APM

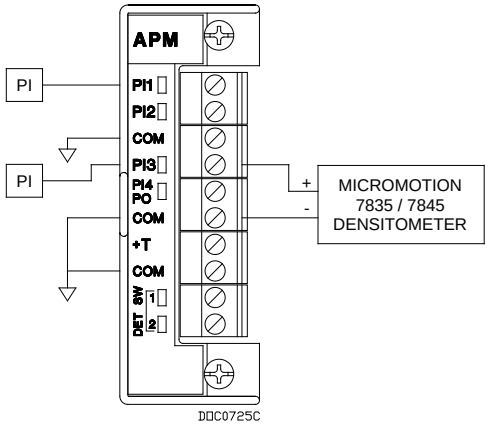


Figure 4-17. Micro Motion (Solartron) 7835/7845 Wiring on APM

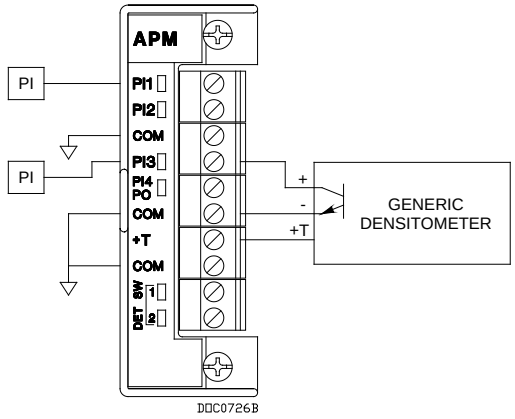


Figure 4-18. Generic Densitometer Wiring on APM

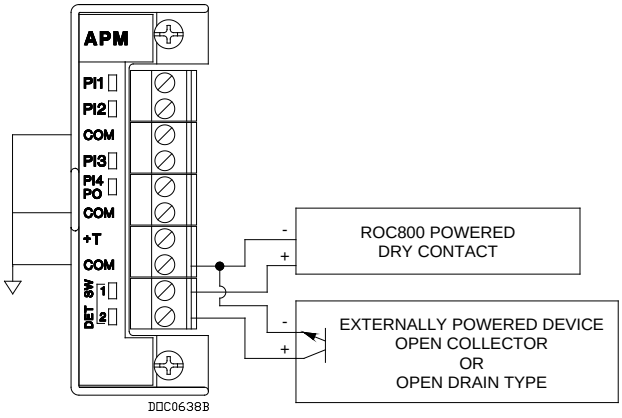


Figure 4-19. Input Detector Wiring on APM

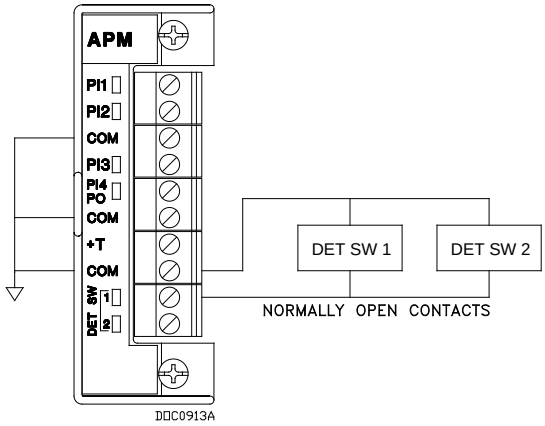


Figure 4-20. Series Detector Switch (Normally Open) Wiring on APM

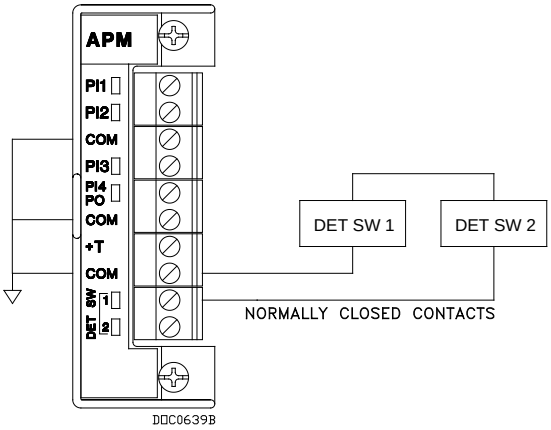


Figure 4-21. Series Detector Switch Wiring (Normally Closed) on APM

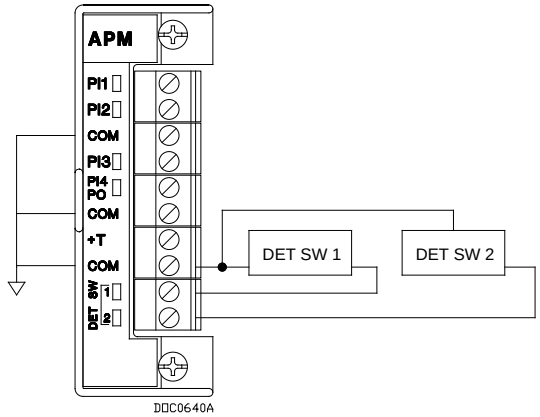


Figure 4-22. Independent Detector Wiring on APM

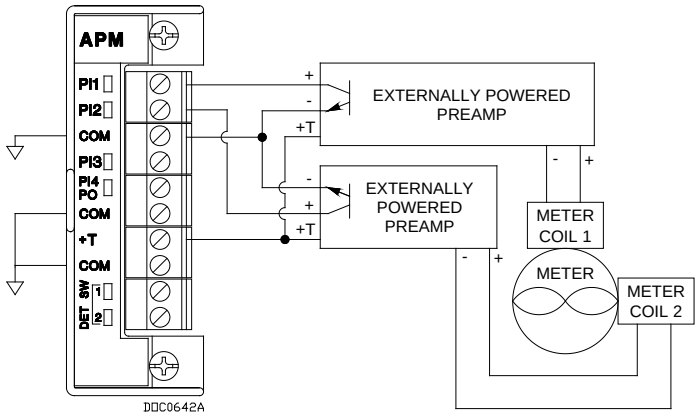


Figure 4-23. Two-Pulse Turbine Pulse Input Wiring on APM

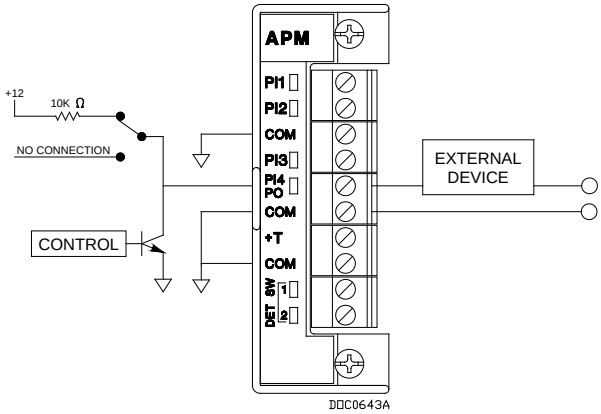


Figure 4-24. Pulse Output Wiring on APM

DIP Switch Settings

The APM card's daughterboard contains several DIP switches which you use to control the module's activities. See *Figure 4-25* for the switch locations and labels; see *Table 4-3* for the settings.

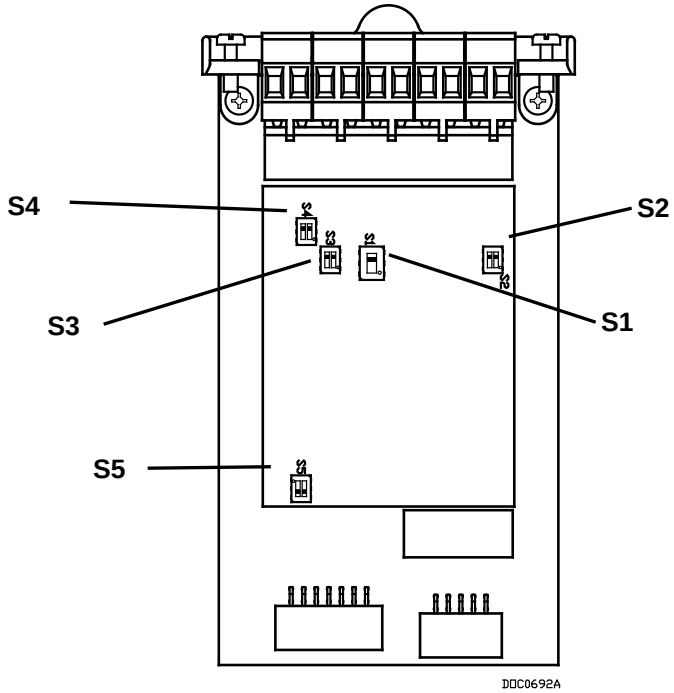


Figure 4-25. DIP Switches on APM

Table 4-3. APM DIP Switch Settings

Switch	Channel	Side[1]	Function	Switch Position[1]
S1	3	N/A	Standard PI	Up
			Current Modulated Densitometer	Down
S2	1	Left	10 kΩ Pullup to 12 V dc	Up
		Left	No Pullup Resistor	Down
	2	Right	10 kΩ Pullup to 12 V dc	Up

Switch	Channel	Side[1]	Function	Switch Position[1]
		Right	No Pullup Resistor	Down
S3[2]	3	Left	10 kΩ Pullup to 12 V dc	Up
		Left	No Pullup Resistor	Down
	4	Right	10 kΩ Pullup to 12 V dc	Up
		Right	No Pullup Resistor	Down
S4	Detector 2	Left	10 kΩ Pullup to 12 V dc	Up
		Left	No Pullup Resistor	Down
	Detector 1	Right	10 kΩ Pullup to 12 V dc	Up
		Right	No Pullup Resistor	Down
S5	4	Left	Pulse Output	Up
		Left	Pulse Input	Down
	N/A	Right	N/A	N/A

[1]Descriptors (up/down/right/left) assume that module terminal blocks face upward and daughterboard is visible (see *Figure 4-25*)
[2]If S1 is down, the 3-channel of this switch is non-functional; the 4-channel still functions normally.

4.11 Multi-Variable Sensor Input/Output (MVS I/O)

The Multi-Variable Sensor Input/Output (MVS I/O) module provides an interface to a sensor that provides differential pressure, static pressure, and temperature inputs for the ROC800 for orifice flow calculation.

MVS I/O or MVS Module?

Remote Automation Solutions offers both an MVS and an MVS I/O module. These modules have identical functions and differ only by where you can place them in the ROC800.

You can place the MVS module (shown on the **left** side of *Figure 4-26*) **only** in the first **three** slots of a ROC800. The enhanced design of the MVS I/O module (shown on the **right** side of *Figure 4-26*) enables you to place it in **any** available slot on the ROC800. In most other ways the two modules are identical.

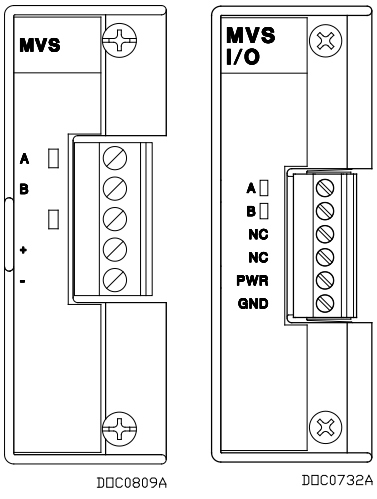


Figure 4-26. MVS and MVS I/O Modules

The MVS I/O module consists of interface electronics that provide the communications link between the ROC800 and the MVS devices. The interface electronics controls communications with the sensor module, provides scaling of process variables, aids calibration, stores operating parameters, performs protocol conversion, and responds to requests from the ROC800.

The ROC800 supports up to two MVS I/O modules. Each MVS I/O module provides the communications interface and the isolated, short-circuit current-limited power required to connect up to six MVS sensors.

Note: The ROC800 supports up to two MVS I/O modules, or two MVS modules, or an MVS I/O module and an MVS module.

The MVS I/O module automatically creates six points, one for each of the six possible MVS channels: 1 – 6 (for one MVS I/O) and 7 – 12 (for a second MVS module). The system assigns points based on which module is in the first slot. For example, if an MVS module is in slot 3, the system automatically assigns it points 1 – 6. If you then install a second MVS module into slot 1, the system re-assigns points so that slot 1 now holds points 1 – 6 and slot 3 holds points 7 – 12.

The ROC800 allows six MVS devices to be connected on its communications bus in a multi-drop connection scheme. You must set the address of each MVS device **prior** to final wiring of multiple MVS devices. For proper operation of multiple MVS devices, each MVS device must have a unique address. **None** of the addresses can be 240. For details on MVS configuration, refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

Once you set a unique address for each MVS, connect the MVS units in a multi-drop arrangement. The only requirement for wiring multi-drop devices is that you tie all like terminals together. This means all the “A” terminals on the devices are electrically connected to the ROC800’s “A” terminal and so on. Wire each remote MVS transmitter in parallel (“daisy-chaining”), as shown in *Figure 4-27*.

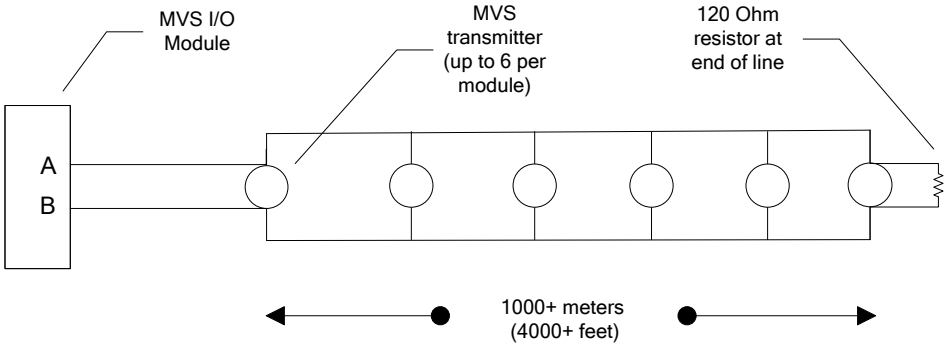


Figure 4-27. MVS Wiring (with Terminators)

Figure 4-29 shows the field wiring diagram for the MVSI/O module.

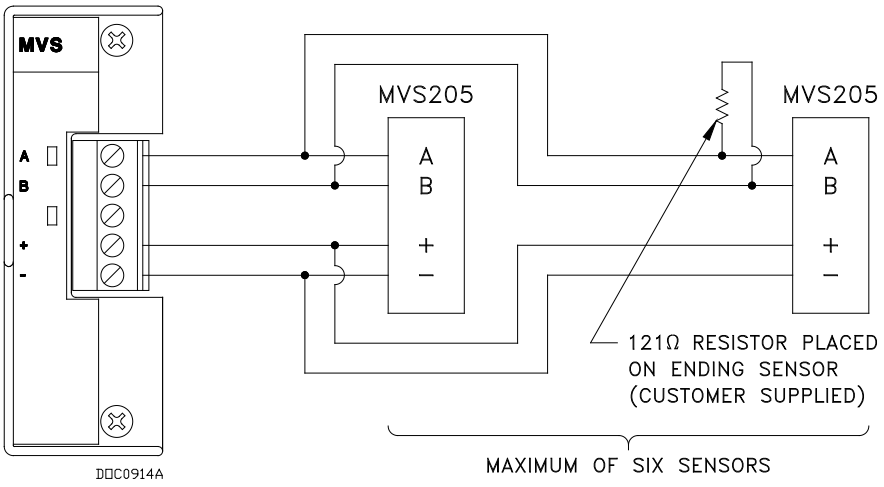


Figure 4-28. MVS Field Wiring

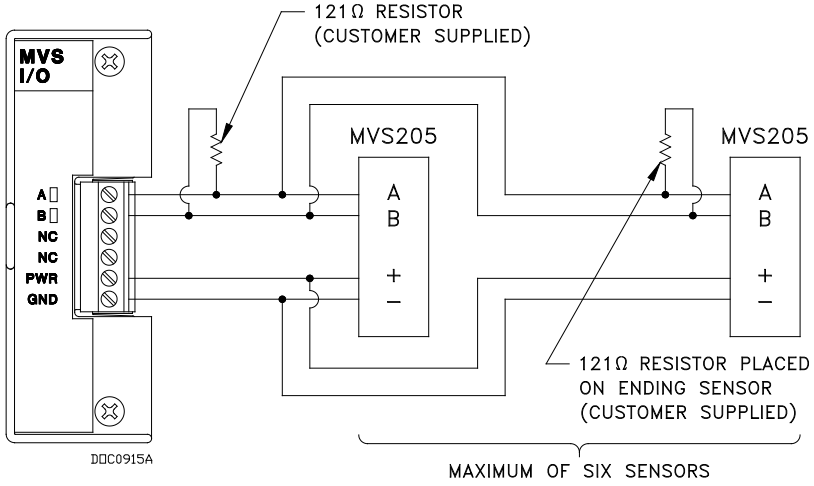


Figure 4-29. MVS I/O Field Wiring

Note: A "star" configuration for transmitters may not be reliable.

Terminations are recommended for long distances (greater that 1000 meters) at the extreme ends of the circuit. Terminate the two outermost devices to reduce signal reflection in the circuit. The MVS termination jumper is located at J4 on the module. Refer to *Table 4-4* and *Figure 4-30*.

Table 4-4. MVS Termination

Jumper	Terminated		Not Terminated	
	TER	OUT	TER	OUT
J4	x			x

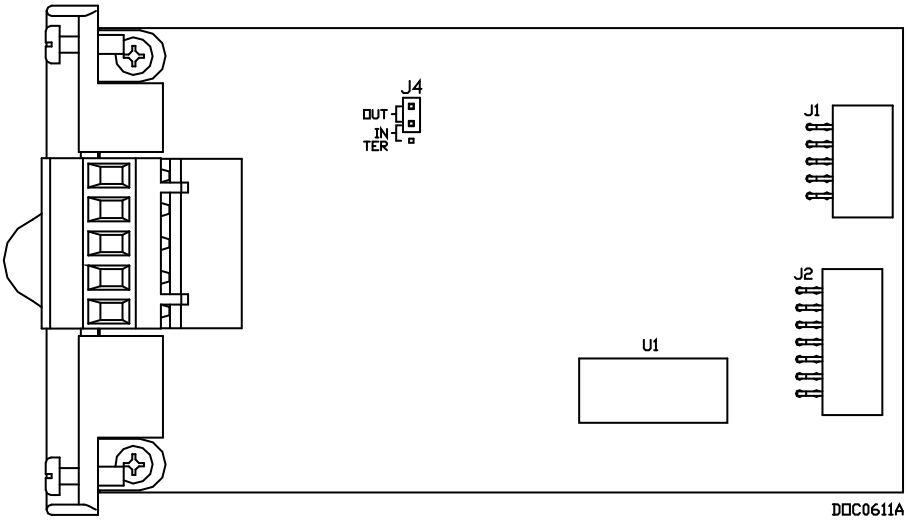


Figure 4-30. MVS Jumper J4 (Shown Not Terminated)

Four wires run from the MVS module terminal block and connect to the sensor. The wires should be a minimum size of 22 AWG and a maximum length of 1220 m (4000 ft).

Note: Insulated, shielded, twisted-pair wiring is required when using MVS signal lines.

Two of the terminal blocks provide power and the other two terminals provide a communication path. *Table 4-5* identifies the terminals.

Table 4-4. MVS Signal Routing

Label	MVS	LED	Terminal
A	RX / TX +	Lit green when receiving	1
B	RX / TX –	N/A	2
None	No Connect	Lit green when transmitting	3
+	Sensor Power	N/A	4
–	Common	N/A	5

Note: **Pay close attention to the connections; do not reverse the power wires.** Make these connections only **after removing power** from the ROC800. Double-check connections for the proper orientation before applying power. If the connections are reversed and power is applied, you may damage **both** the MVS module and the ROC800-Series processor board.

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

4.12 Alternating Current Input/Output (AC I/O) Module

Warning **EMC issues restrict the use of the AC I/O module only to devices using a PM-12 power module. You cannot use the AC I/O module in a device that uses either a PM-24 or PM-30 power module.**

Switchable I/O and LEDs

The module has one bank of six DIP switches on its daughterboard (see *Figure 4-31*), which controls the input/output status of each of the six channels. Placing a switch in the ON position sets the corresponding channel to output mode. Placing a switch in the OFF position sets the channel to input mode. Dual-color light-emitting diodes (LEDs) indicate the current status for each channel. Red means AC source is being output. Green means the module has detected AC on an input channel.

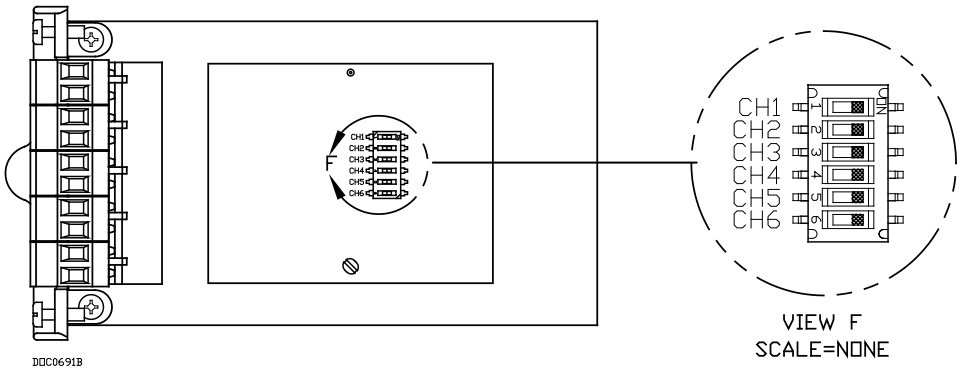


Figure 4-31. AC I/O DIP Switches

AC Discrete Outputs

In output mode, the module provides up to six channels for switching discrete AC. Each channel uses a solid-state normally open relay rated at 1.5 Amps. Any AC switched out is directly related to the AC switched in. Using ROCLINK 800, you can configure the module as latched, toggled, momentary, or Timed Duration Outputs (TDOs). Other parameters report the approximate load, over-current conditions, and AC input status. Discrete outputs can be configured to either retain the last value on reset or a user-specified fail-safe value. See *Figure 4-32*.

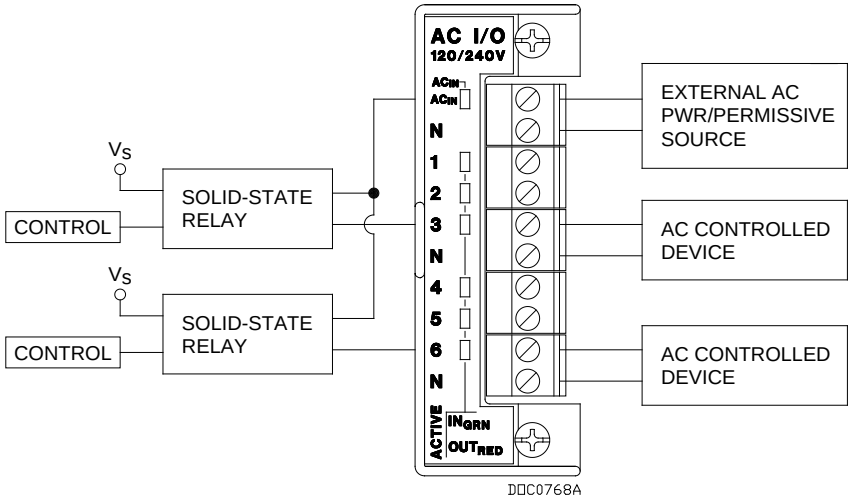


Figure 4-32. AC I/O Module (Output Field Wiring)

Note: If the label on your AC I/O module **does not** indicate 120/240V, your module is designed for use **only** with 120V. Additionally, all AC wiring must be shielded.

AC Discrete Inputs

You can configure each channel as an AC input/detector. Each channel can detect the presence of an AC signal between 90 and 265 Vrms at 47 to 63 Hz. In discrete input mode the module monitors the status of various AC sources.

You can also software-configure each channel to function as a latched DI, which remains in active state until reset. Other parameters can invert the field signal and gather statistical information on the number of transitions and the time accumulated in the on or off state. The fastest time that each channel within the module can be read is 20 times per second. See *Figure 4-33.*

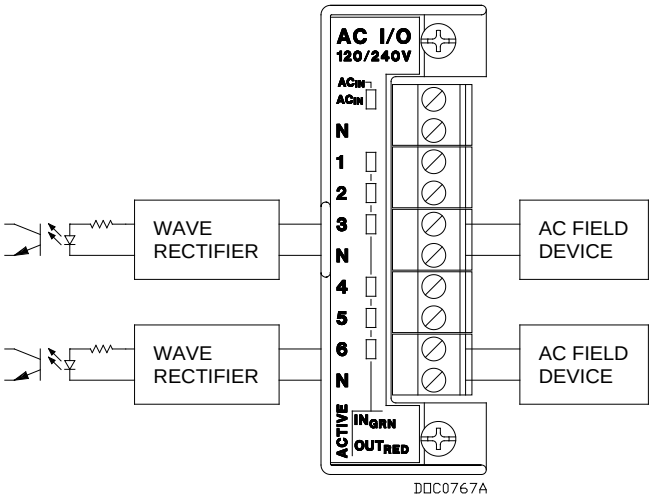


Figure 4-33. AC I/O Module (Input Field Wiring)

Note: If the label on your AC I/O module **does not** indicate 120/240V, your module is designed for use **only** with 120V. Additionally, all AC wiring must be shielded.

Table 4-5. Field Wiring Terminals

Terminal	Label	Definition
1	AC In	AC Input (Permissive Power)
2	N	AC Neutral
3	1	Channel 1
4	2	Channel 2
5	3	Channel 3
6	N	AC Neutral
7	4	Channel 4
8	5	Channel 5
9	6	Channel 6
10	N	AC Neutral

The field terminal wiring has the following definitions:

Term	Definition
AC Input	The AC power applied to this terminal is the source for any channel that is configured as an output. The input to this terminal should be externally fused with a 10 to 15 amp fuse. The channel has a green LED associated with it to indicate when power is applied. This terminal is typically wired to the permissive/safety circuitry so that if this circuit trips, all power is removed from the channels that are configured as AC outputs.
AC Neutral	This terminal is connected to the system AC neutral and is used a reference for all AC power.
Channels 1 through 6	Depending upon the configuration of the DIP switch, each channel can be configured as an input or an output.

4.13 Thermocouple (TC) Input Module

Caution **The TC2 module is NOT supported in the Series 1 CPU.**

The four-channel Thermocouple Input module monitors types B, C, E, J, K, N, R, S, or T thermocouples, based on how you configure the module with ROCLINK 800 Configuration software. The type of thermocouple refers to the material used to make a bimetallic junction. Dissimilar materials in the junction generate different millivolt levels as a function of the heat to which the materials are exposed.

The Thermocouple module measures the voltage of the thermocouple to which it is connected. The TC voltage is measured and a Cold Junction

Compensation (CJC) correction factor is applied to compensate for errors due to any voltage inducted at the wiring terminals by the junction between the different metal of the TC wiring and the TC module's terminal blocks.

Note: The use of dissimilar metals is not supported. It does not provide the correct results, as CJC is applied at the module level.

Thermocouples are self-powered and require no excitation current. The TC module uses integrated short-circuit protected isolated power supplies and completely isolates the field wiring side of the module from the backplane.

⚠ Caution **If using the Type J above 750°C (1382°F), abrupt magnetic transformation causes permanent de-calibration of the TC wires.**

De-calibration

De-calibration can occur in thermocouple wires. De-calibration is the process of unintentionally altering the makeup of the thermocouple, usually caused by the diffusion of atmospheric particles into the metal at the extremes of the operating temperature range. Impurities and chemicals can cause de-calibration from the insulation diffusing into the thermocouple wire. If operating at high temperatures, check the specification of the probe insulation. It is advised to use thermocouples with insulated junctions to protect against oxidation and contamination.

Thermocouples use thin wire (typically 32 AWG) to minimize thermal shunting and increase response times. Wire size used in the thermocouple depends upon the application. Typically, when longer life is required for the higher temperatures, select the larger size wires. When sensitivity is the prime concern, use smaller size wiring. Thin wire causes the thermocouple to have a high resistance that can cause errors due to the input impedance of the measuring instrument. If thermocouples with thin leads or long cables are required, keep the thermocouple leads short and use a thermocouple extension wire to run between the thermocouple and measuring instrument.

The thermocouple connects directly to the module's removable terminal block (see *Figure 4-34*). No special terminal or isothermal block is required.

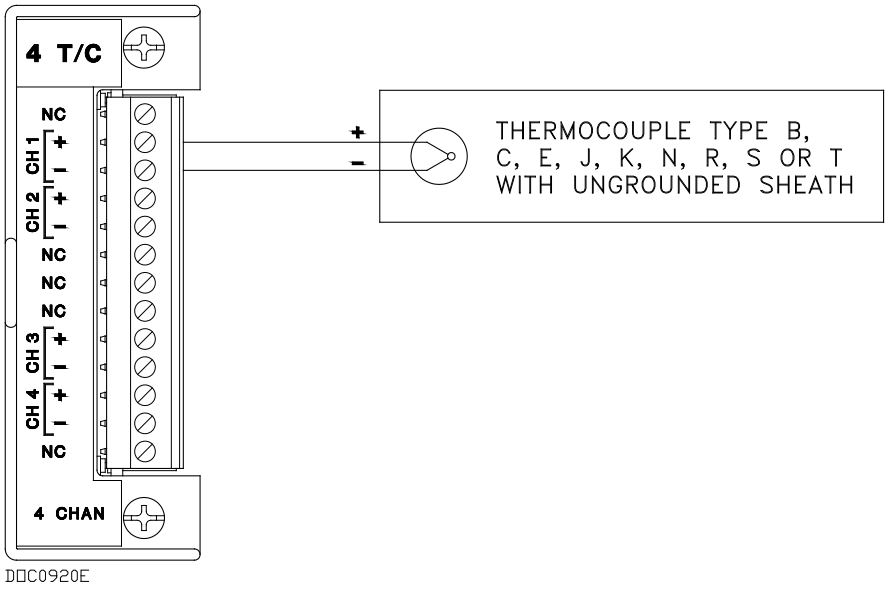


Figure 4-34. Thermocouple Input Module Wiring

Be sure to use the correct type of thermocouple wire to connect the thermocouple to the ROC800. Minimize connections and make sure connections are tight. If you use any dissimilar metals (such as copper wire) to connect a thermocouple to the ROC800, you can create the junction of dissimilar metals that can generate millivolt signals and increase reading errors.

Ensure any plugs, sockets, or terminal blocks used to connect the extension wire are made from the same metals as the thermocouples and observe correct polarity.

The thermocouple probe must have sufficient length to minimize the effect of conduction of heat from the hot end of the thermocouple. Unless there is insufficient immersion, readings will be low. It is suggested the thermocouple be immersed for a minimum distance equivalent to four times the outside diameter of a protection tube or well.

Use only ungrounded thermocouple constructions. Grounded thermocouples are susceptible to the creation of ground loops. In turn, ground loops can cause interaction between thermocouple channels on the thermocouple module.

Note: Use thermocouples as individual sensing devices. All modules are isolated on the field side. Be aware that you can induce ground loops by tying module-to-module commons together.

Noise Susceptibility

Millivolt signals are very small and are very susceptible to noise. Noise from stray electrical and magnetic fields can generate voltage signals higher than the millivolt levels generated from a thermocouple. The TC modules can reject common mode noise (signals that are the same on both wires), but rejection is not perfect,

so minimize noise where possible.

Take care to properly shield thermocouple wiring from noise by separating the thermocouple wiring runs from signals that are switching loads and AC signals. Route wires away from noisy areas and twist the two insulated leads of the thermocouple cable together to help ensure both wires pick up the same noise. When operating in an extremely noisy environment, use a shielded extension cable.

⚠ Caution **Shielded wiring is highly recommended. Ground shields only on one end, preferably at the end device unless you have an excellent ground system installed at the ROC800-series controller. Do not tie the thermocouple module to ground.**

Sheathed thermocouple probes are available with one of three junction types: grounded, ungrounded, or exposed.

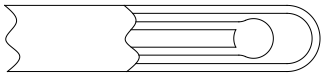


Figure 4-35. Ungrounded – Sheathed

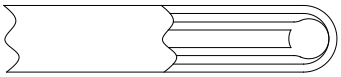


Figure 4-36. Grounded

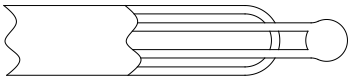


Figure 4-37. Exposed, Ungrounded – Unsheathed

In an **ungrounded** probe, the thermocouple junction is detached from the probe wall. Response time slows down from the grounded style, but the ungrounded probe offers electrical isolation of 1.5 M Ω at 500 Volts dc in all diameters. The wiring may or may not be sheathed.

Note: Only **ungrounded** probes are supported. It is highly recommended that you use sheathed probes.

Use an ungrounded junction for measurements in corrosive environments where it is desirable to have the thermocouple electronically isolated from and shielded by the sheath. The welded wire thermocouple is physically insulated from the thermocouple sheath by MgO powder (soft).

At the tip of a **grounded** junction probe, the thermocouple wires physically attach to the inside of the probe wall. This results in good heat transfer from the outside, through the probe wall to the thermocouple junction. Grounded wiring is not supported.

The thermocouple in the **exposed** junction protrudes out of the tip of the sheath and is exposed to the surrounding environment. This type offers the best response time, but is limited in use to non-corrosive and non-pressurized applications. **Exposed junction thermocouples are not supported.**

Note: Avoid subjecting the thermocouple connections and measurement instrument to sudden changes in temperature.

4.14 Highway Addressable Remote Transducer (HART®) Module

Note: The HART-2 module (labeled **HART-2** with black faceplate) replaces the HART module (with gray faceplate).

The HART-2 module allows a ROC800 to communicate with HART devices using the HART protocol. The HART-2 module receives signals from and transmit signals to HART devices. LEDs provide a visual indication of the status of each HART channel. Refer to *Figure 4-38*.

Note: HART Pass-Through requires you to use the HART Pass-Through license key (FS8KY-6), which provides PlantWeb® Smart Remote Automation functionality. This includes the ability to pass HART data bi-directionally through the network to AMS™ Device Manager software.

The module has four input/output channels. The HART-2 module uses software-configurable switches, which allow you to set each channel as input or output. When you set a channel as an input, you can configure it for use in point-to-point or multi-drop mode (which typically connects to some type of transmitter, such as a temperature reading). When you configure a channel as an output, it reverts to point-to-point mode **only**. The output supports a Digital Valve Controller (DVC). Each channel has analog input capability intended for diagnostic and primary process variable measurement.

Frequency Shift Keying

HART superimposes Frequency Shift Keying (FSK) signals on an analog signal. This technique allows digital information to be passed to and from the HART device on a 4 to 20 mA analog signal.

Point-to-Point Mode

In **point-to-point** mode, the analog signal is still representative of the measured variable. This mode allows communications with one HART device per channel.

Multi-drop Mode

In **multi-drop mode**, you can connect up to five HART devices (in parallel) to each channel. As with the point-to-point mode, digital communications are superimposed on the analog signal used to power the HART devices. Each HART device in multi-drop mode requires 4 mA and the current does not represent any measured variable value. With all four channels in the multi-drop mode, the ROC800 can support a maximum of twenty HART devices.

A ROC800 equipped with a HART-2 module is considered to be a HART Host (primary master) interface with a Class 1 Conformance classification. The HART-2 module can also be configured with ROCLINK 800 Configuration software for use as a secondary master in redundant applications.

Most Universal and some Common Practice commands are supported. For a list of the commands, refer to the ROC800-Series HART Module technical specification sheet (*ROC800:HART2*). The supported

commands conform to HART Universal Command Specification Revision 5.1 and Common Practice Command Specification Revision 7, (HCF SPEC 127 and 151). Refer to *www.hartcomm.org* for more information on the specifications.

The HART-2 module polls the channels simultaneously. If more than one device is connected to a channel in a multi-drop configuration, the module polls one device per channel at a time. The HART protocol allows one second per poll for each device, so with five devices per channel the maximum poll time for the channel would be five seconds.

Note: The ROC800 **does not** support HART devices configured in Burst mode (in which the device sends information without a prior request). If you have a HART device configured in burst mode, use a hand-held field communicator to turn off burst mode **before** you connect the device to the ROC800.

The HART-2 module provides "loop source" power (+T) and four channels (1+ through 4+) for communications. The +T power is current-limited.

ROC-powered HART Devices

When using the ROC800 to power HART devices, connect terminal +T in parallel to the positive (+) terminal on all of the HART devices, regardless of the channel to which they are connected.

Wire channel 1+ to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of the devices. Likewise, wire channel 2+ to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of a second group of HART devices (see *Figure 4-40*).

Externally powered HART Devices

When powering HART devices by an external device, connect the positive (+) terminal from the power source in parallel to the positive (+) terminal on all of the HART devices, regardless of the channel to which they are connected.

Wire channel 1+ on the HART-2 module to the positive (+) terminal of the HART device. Connect the power source negative (–) terminal to the channel's COM terminal and to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of the HART devices.

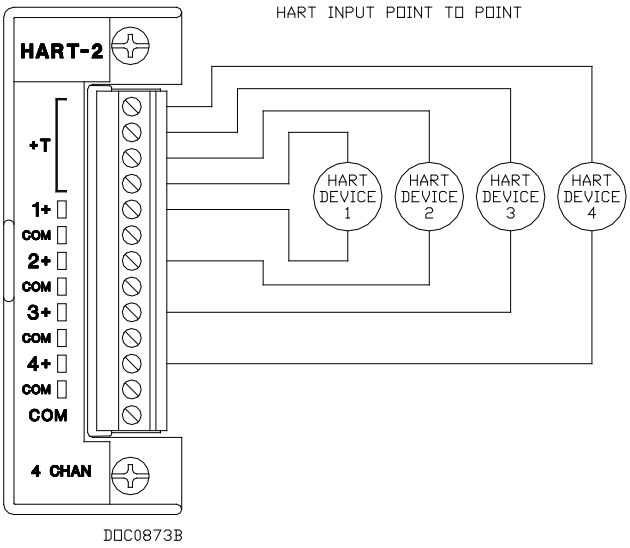


Figure 4-38. Input Point-to-Point Wiring on HART-2 Module

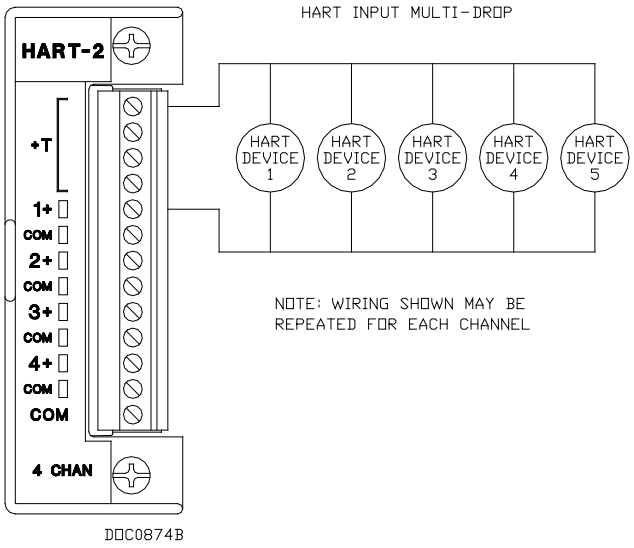


Figure 4-39. Input Multi-Drop Wiring on HART-2 Module

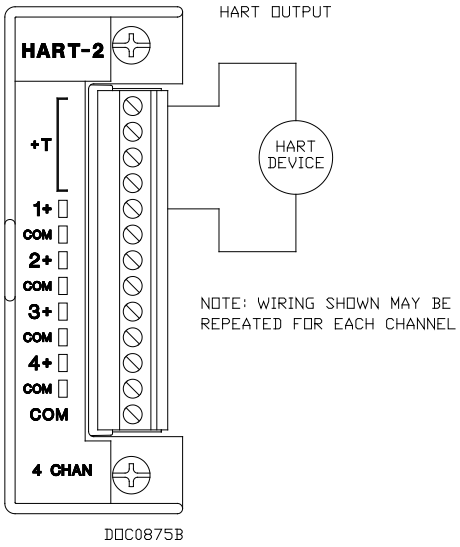


Figure 4-40. Output Wiring on HART-2 Module

4.15 IEC 62591 Module

The IEC 62591 Interface module allows a ROC800-Series Remote Operations Controller (ROC800) to communicate with any mix of up to 60 *Wireless*HART™ field devices. The module supports monitoring of both the process information contained in the remote terminal unit (RTU) and the intelligent diagnostic information residing in the *Wireless*HART field devices.

The IEC 62591 Interface consists of two parts: the Smart Wireless Field Link that provides the radio link to the *Wireless*HART field devices, and the IEC 62591 Interface Module that installs into the ROC800.

Installation and Configuration

The IEC 62591 Interface module connects to the Smart Wireless Field Link through a four-wire connection. This allows the Smart Wireless Field Link to be strategically placed away from the controller in the optimal location for best network performance. The module provides 12 Vdc loop-output to power the Smart Wireless Field Link.

You can install one IEC 62591 Interface module in any slot on a ROC800. Modules can be easily installed or removed from the module slots at any time by removing the two captive screws accessible from the front of the unit.

IEC 62591 Interface modules are hot-swappable, meaning the module can be removed and another module of the same kind can be installed. IEC 62591 Interface modules are hot-pluggable, meaning they may be installed directly into unused module slots under power.

The module has a removable terminal block for convenient wiring and servicing. The terminal block can accommodate size 24 to 16 American Wire Gauge (AWG). A USB port is provided on the module to perform firmware updates and to provide debug information to support personnel.

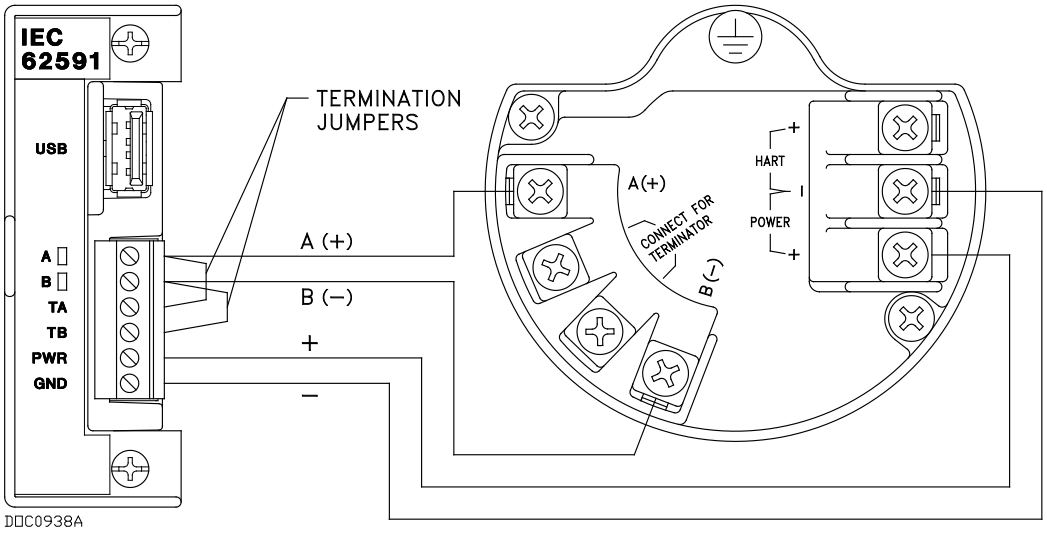


Figure 4-41. Wiring on IEC62591 Module

4.16 APP 485 Module

The Application module (APP 485) provides a solution to add user applications to the ROC800-Series (ROC800) by simply installing a module. The APP 485 module streamlines the installation process by including all point types and screens associated with the application, and the module is automatically recognized by ROC800 firmware. In addition to the user application, the APP 485 module provides an onboard RS-485 communications port that enables communications without utilizing one of the built-in communications ports on the ROC800.

APP 485 modules can house a variety of applications including Modbus express and more. For more information about available applications, contact your sales representative.

The APP 485 module enables the ROC800 to communicate directly with field devices using the EIA-485 (RS-485) communications port included on the module. The module serves as an interface between the field devices and the ROC800. Supported protocols include Modbus host and slave (RTU or ASCII) and ROC. LEDs on terminals A and B provide you with visual feedback on communication activity status.

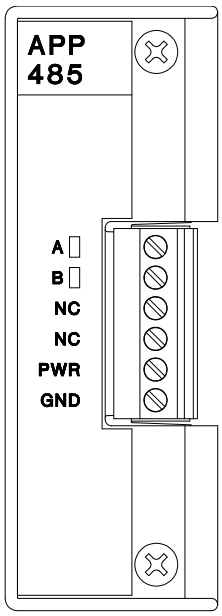


Figure 4-42. APP 485 Module

4.17 Additional Technical Information

Refer to the following technical documentation (available at *www.EmersonProcess.com/Remote*) for additional and most-current information on each of the I/O modules.

Table 4-6. I/O Module Technical Specifications

Name	Form Number	Part Number
ROC800-Series Analog Input Modules	ROC800:AI	D301238X012
ROC800-Series Alternating Current I/O Module	ROC800:ACIO	D301243X012
ROC800-Series Analog Output Module	ROC800:AO	D301260X012
ROC800-Series Advance Pulse Module	ROC800:APM	D201231X012
ROC800-Series Discrete Input Module	ROC800:DI	D301274X012
ROC800-Series Discrete Output Module	ROC800:DO	D301592X012
ROC800-Series Discrete Output Relay Module	ROC800:DOR	D301593X012
ROC800-Series HART® Module	ROC800:HART2	D301705X012
ROC800-Series MVS I/O Module	ROC800:MVS	D301277X012
ROC800-Series Pulse Input Module	ROC800:PI	D301275X012
ROC800-Series Resistance Temperature Detector Module	ROC800:RTD	D301574X012
ROC800-Series Thermocouple Module	ROC800:TC2	D301689X012
ROC800-Series IEC 62591 Interface	ROC800:62591	D301712X012
ROC800-Series ROC800-Series Application Module	ROC800:APP	D301741X012

Chapter 5 – Communications

This chapter describes the built-in communication ports and the optional communication modules used with the ROC800.

In This Chapter

5.1 Communication Ports and Modules Overview 5-1
5.2 Installing Communication Modules 5-3
5.3 Removing a Communication Module 5-5
5.4 Wiring Communication Modules 5-5
5.5 Local Operator Interface (LOI) 5-5
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5.6 Ethernet Communication 5-7
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5.8 EIA-422/485 (RS-422/485) Serial Communications Module 5-10
5.8.1 EIA-422/485 (RS-422/485) Jumpers & Termination Resistors 5-11
5.9 Dial-up Modem Communication Module 5-13
5.10 Multi-Variable Sensor (MVS) Interface Module 5-14
5.11 Network Radio Module (NRM) 5-14
5.12 Additional Technical Information 5-16

Note: For information on removing or installing wire covers or module slot covers, see *Chapter 4*.

5.1 Communication Ports and Modules Overview

The built-in communication ports and the optional communication modules provide communications between the ROC800 and a host system or external devices.

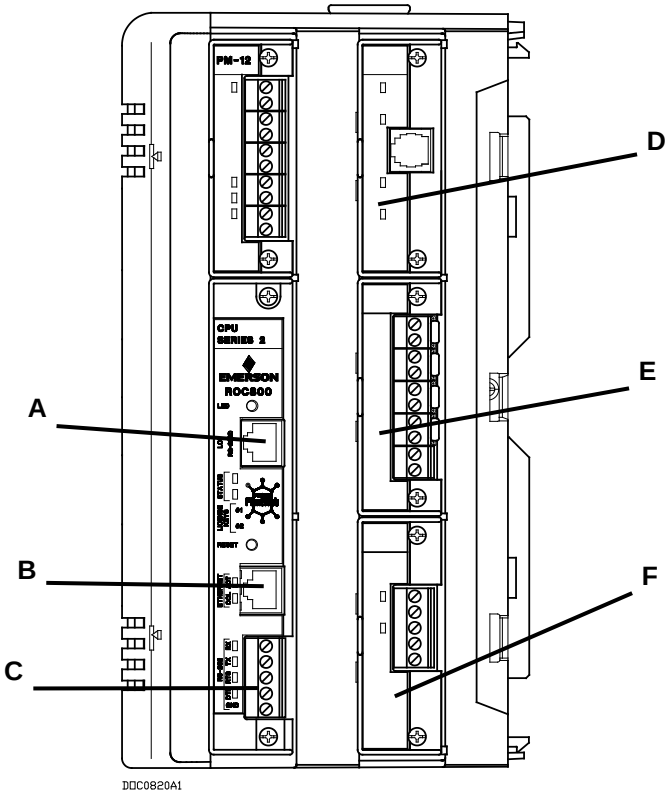
The ROC800 supports up to six communication ports. The CPU provides three built-in communication ports. You can add up to three additional ports with communication modules. *Table 5-1* displays the types of communication options available for the ROC800.

Table 5-1. Built-in Communication and Optional Communication Modules

Communications	Built-in on CPU	Optional Module
EIA-232 (RS-232D) Local Operator Interface (LOI)	Local Port	
Ethernet (use with DS800 Configuration Software)	Comm1	
EIA-232 (RS-232C) Serial Communication	Comm2	Comm3 to Comm5
EIA-422/485 (RS-422/485) Serial Communication		Comm3 to Comm5
Modem Communication		Comm3 to Comm5
MVS Sensor Interface		Comm3 to Comm5

The communication modules consist of a printed circuit board, a communication port, wiring terminal block, LEDs, and connectors to

the backplane. The ROC800 can hold up to three communication modules in the first three module slots. Refer to *Figure 5-1*.



A LOI (Local Port) EIA-232 (RS-232D)
B Built-in Ethernet (Comm1)
C Built-in EIA-232 (RS-232) (Comm2)
D Optional Comm 3 (Slot #1)
E Optional Comm 3 or Comm 4 (Slot #2)
F Optional Comm 3 to Comm 5 (Slot #3)

Figure 5-1. Communication Ports

Table 5-2. RS-232 Communication LED Indicator Definitions

Signals	Action
CTS	**Clear To Send** indicates the modem is ready to send.
CD	Data **Carrier Detect** (DCD) indicates a valid carrier signal tone detected.
DSR	**Data Set Ready** for ring indicator communication signal.
DTR	**Data Terminal Ready** to answer an incoming call. When off, a connection disconnects.
RTS	**Ready To Send** indicates ready to transmit.
RX	**Receive Data** (RD) signal is being received.
TX	**Transmit Data** (TD) signal is being transmitted.

Each communication module has surge protection in accordance with the CE certification EN 61000. With the exception of the EIA-232 (RS-232) module, every communication module is isolated from other modules and the backplane, including power and signal isolation. The

field interface has been designed to protect the electronics in the module. Filtering is provided on each module to reduce communication errors.

5.2 Installing Communication Modules

All communication modules install into the ROC800 in the same way.

⚠ Caution **The design of ROC800-Series communication and I/O modules supports "hot-swapping" (replacing similar modules in the same slot) and "hot-plugging" (inserting modules into an empty slot) while the ROC800 is powered. However, it is a good safety practice with any electrical device to first remove power before you make internal connections. If you find it necessary to hot-swap or hot-plug a module, first review the most current specification sheet for that module to ensure both your safety and the integrity of data that module may provide.**

Modules are self-identifying in the software and all modules are self-resetting after a fault clears.

Note: The dial-up modem module is **neither** hot-swappable **nor** hot-pluggable. When you install a dial-up modem module, you **must** remove power from the ROC800.

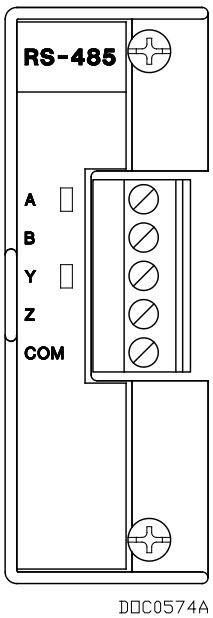


Figure 5-2. RS-485 Communication Module

⚠ Caution **When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.**

Note: With the exception of the HART module, you can install communication modules **only** in slots 1, 2, or 3 of the ROC800. Refer to *Figure 5-1* and *Table 5-1*.

1. Remove the wire channel cover.

   Note: Leaving the wire channel cover in place can prevent the module from correctly connecting to the socket on the backplane.

2. Perform one of the following:
   - If there is a module currently in the slot, unscrew the captive screws and remove that module (refer to *Removing a Communication Module*).
   - If the slot is currently empty, remove the module cover.

3. Insert the new module through the module slot on the front of the ROC800 or EXP housing. Make sure the label on the front of the module is facing right side up. Gently slide the module in place until it contacts properly with the connectors on the backplane.

   Note: If the module stops and will not go any further, **do not** force the module. Remove the module and see if the pins are bent. If so, gently straighten the pins and re-insert the module. The back of the module **must** connect fully with the connectors on the backplane.

4. Gently press the module into its mating connectors on the backplane until the connectors firmly seat.
5. Tighten the retaining captive screws on the front of the module.
6. Wire the module (refer to *Wiring Communication Modules*).

   Note: All modules have removable terminal blocks for convenient wiring and servicing. Twisted-pair cable is recommended for I/O signal wiring. The removable terminal blocks accept 12 to 22 AWG wire.

7. For dial-up modem communication, connect the cable to the RJ-11 connector on the communication module.

   Note: If you are installing a modem module, it is recommended that you install a surge protector between the RJ-11 jack and the outside line.

8. Replace the wire channel cover.
9. Connect to ROCLINK 800 software and login. The modules are self-identifying after re-connecting to ROCLINK 800 software.

5.3 Removing a Communication Module

To remove a communication module:

1. Remove the wire channel cover.
2. Unscrew the two captive screws holding the module in place.
3. Gently pull the module's lip out and remove the module from the slot. You may need to gently wiggle the module.
4. Install a new module or install the module cover.
5. Screw the two captive screws to hold the module cover in place.
6. Replace the wire channel cover.

5.4 Wiring Communication Modules

You make signal wiring connections to communication through the communication port's removable terminal block connectors and through RJ-11 and RJ-45 connectors. All modules have removable terminal blocks for convenient wiring and servicing. The terminal blocks can accept 12 to 22 AWG wire.

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

To connect the wire to the removable block compression terminals:

1. Bare the end (¼ inch maximum) of the wire.
2. Insert the bared end into the clamp beneath the termination screw.
3. Tighten the screw.

The ROC800 should have a minimum of bare wire exposed to prevent short circuits. Allow some slack when making connections to prevent strain.

Note: All modules have removable terminal blocks for convenient wiring and servicing. Twisted-pair cable is recommended for I/O signal wiring. The removable terminal blocks accept 12 to 22 AWG wire.

5.5 Local Operator Interface (LOI)

The Local Operator Interface (LOI) port (see *Figure 5-1*) provides direct communication between the ROC800 and the serial port of an operator interface device, such as a personal computer running Microsoft® Windows®. The interface allows you to access the ROC800 with a

direct connection using ROCLINK 800 software to configure and transfer stored data.

The LOI uses the Local Port in ROCLINK 800 software.

The LOI terminal (RJ-45) on the CPU provides wiring access to a built-in EIA-232 (RS-232) serial interface, which is capable of 57.6K baud operation. The RJ-45 connector pin uses the data terminal equipment (DTE) in the IEEE standard.

The LOI port supports ROC Plus and Modbus protocol communication. The LOI also supports the log-on security feature of the ROC800 if you have enabled the Security on LOI in the ROCLINK 800 software.

Table 5-3 shows the signal routing of the CPU connections. *Figure 5-3* shows the RJ-45 pin out.

Table 5-3. Built-in LOI EIA-232 Signal Routing

Signal	LOI Function	RJ-45 Pins on ROC800	Description
DTR	Data Terminal Ready	3	Originated by the ROC800 Data Terminal Equipment (DTE) to instruct the Data Communication Equipment (DCE) to set up a connection. DTE is running and ready to communicate.
GND	Ground (Common)	4	Reference ground between a DTE and a DCE and has a value 0 Volts dc.
RX	Receive	5	Data received by the DTE.
TX	Transmit	6	Data sent by the DTE.
RTS	Request to Send	8	Originated by the DTE to initiate transmission by the DCE.

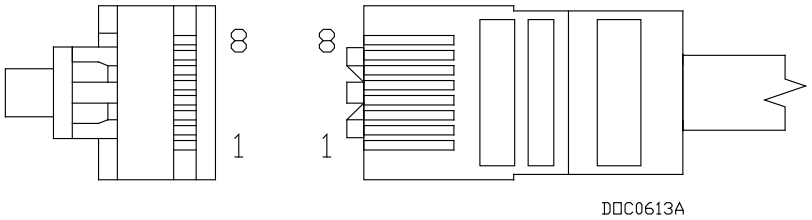


Figure 5-3. RJ-45 Pin Out

The LOI terminal requires you to install a D-Sub 9 pin (F) to RJ-45 modular converter between the ROC800 and PC. Refer to *Table 5-4*.

Table 5-4. RJ-45 to EIA-232 (RS-232) Null-modem Cable Signal Routing

EIA-232 (RS-232) DTE	ROC800-Series	RJ-45 Pins on ROC800-Series
4	–	1
1	–	2
6	DTR	3
5	GND	4
3	TX	5

EIA-232 (RS-232) DTE	ROC800-Series	RJ-45 Pins on ROC800-Series
2	RX	6
7	–	7
8	RTS	8

Adaptor Cable Remote Automation Solutions offers an adaptor cable to resolve this cabling issue. Order CBL8A from your Remote Automation Solutions salesperson.

5.5.1 Using the LOI

1. Plug the LOI cable into the LOI RJ-45 connector of the ROC800.
2. Connect the LOI cable to the D-Sub 9 pin (F) to RJ-45 modular converter.
3. Plug the modular converter into the COM port of the PC.
4. Launch ROCLINK 800 software.
5. Click the **Direct Connect** icon on the ROCLINK 800 tool bar.
6. Configure communication for the other built-in and modular communications, I/O modules, AGA meter parameters, and other configuration parameters.

5.6 Ethernet Communication

The Ethernet communication port in the ROC800 supports TCP/IP protocol communication using the IEEE 802.3 10Base-T standard. One application of this communication port is to download programs from DS800 Development Suite Configuration Software.

Default TCP/IP The ROC800 uses the following factory defaults:

- TCP/IP: 10.0.02
- Gateway: 10.0.0.1
- Subnet Mast: 255.255.255.0

The Ethernet communication port uses a 10BASE-T Ethernet interface with an RJ-45 connector. Each Ethernet-equipped unit is called a “station” and operates independently of all other stations on the network without a central controller. All attached stations connect to a shared media system. Signals are broadcast over the medium to every attached station. To send an Ethernet packet, a station listens to the medium (Carrier Sense) and when the medium is idle, the station transmits the data. Each station has an equal chance to transmit (Multiple Access).

The Medium Access Control (MAC) mechanism embedded in each station interface determines access to the shared medium. The MAC

mechanism is based on Carrier Sense Multiple Access with Collision Detection (CSMA/CD). If two stations begin to transmit a packet at the same instant, the stations stop transmitting (Collision Detection). Transmission is rescheduled at a random time interval to avoid the collision.

You can link Ethernet networks together to form extended networks using bridges and routers.

Table 5-5. Ethernet Signal LEDs

Series 1 CPU

Signal	Function
RX	Lit when currently receiving.
TX	Lit when currently transmitting.
COL	Lit when Ethernet Packet Collision detected.
LNK	Lit when Ethernet has linked.

Series 2 CPU

Signal	Function
COL	Lit when Ethernet Packet Collision detected.
ACT	Blinks when activity (TX, RX, or LNK) occurs.

Use a rugged industrial temperature HUB when connecting Ethernet wiring in an environment that requires it.

The IEEE 802.3 10BASE-T standard requires that 10BASE-T transceivers be able to transmit over a link using voice grade twisted-pair telephone wiring that meets EIA/TIA Category four wire specifications. Generally, links up to 100 meters (328 feet) long can be achieved for unshielded twisted-pair cable.

For each connector or patch panel in the link, subtract 12 meters (39.4 feet) from the 100-meter limit. This allows for links of up to 88 meters (288 feet) using standard 24 AWG UTP (Unshielded Twisted-Pair) wire and two patch panels within the link. Higher quality, low attenuation cables may be required when using links greater than 88 meters.

The maximum insertion loss allowed for a 10BASE-T link is 11.5 dB at all frequencies between 5.0 and 10.0 MHz. This includes the attenuation of the cables, connectors, patch panels, and reflection losses due to impedance mismatches to the link segment.

Intersymbol interference and reflections can cause jitter in the bit cell timing, resulting in data errors. A 10BASE-T link must not generate more than 5.0 nanoseconds of jitter. If your cable meets the impedance requirements for a 10BASE-T link, jitter should not be a concern.

The maximum propagation delay of a 10BASE-T link segment must not exceed 1000 nanoseconds.

Signal coupling between the different cable pairs contained within a multi-pair cable bundle causes “crosstalk.” 10BASE-T transceivers are

designed so that you do not need to be concerned about cable crosstalk, provided the cable meets all other requirements.

Noise can be caused by crosstalk of externally induced impulses. Impulse noise may cause data errors if the impulses occur at very specific times during data transmission. Generally, do not be concerned about noise. If you suspect noise related data errors, it may be necessary to either reroute the cable or eliminate the source of the impulse noise.

Multi-pair, PVC 24 AWG telephone cables have an attenuation of approximately 8 to 10 dB/100 m at 200°C (392°F). The attenuation of PVC insulted cable varies significantly with temperature. At temperatures greater than 400°C (752°F), use plenum-rated cables to ensure that cable attenuation remains within specification.

When connecting two twisted-pair Medium Attachment Units (MAUs) or repeaters together over a segment, wire the transmit data pins of one eight-pin connector to the receive data pins of the other connector, and vice versa. There are two methods for accomplishing 10BASE-T crossover wiring:

- Using special cable.
- Wiring the 10BASE-T crossover inside the hub.

For a single segment connecting only two devices, provide the signal crossover by building a special crossover cable, wire the transmit data pins of one eight-pin connector to the receive data pins of the other connector, and vice versa. Refer to *Figure 5-4*.

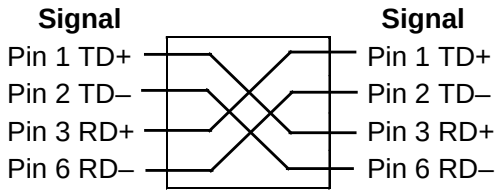


Figure 5-4. 10BASE-T Crossover Cable

5.7 EIA-232 (RS-232) Serial Communication

The built-in EIA-232 (RS-232), the LOI, and the communication modules meet all EIA-232 (RS-232) specifications for single-ended, asynchronous data transmission over distances of up to 15 meters (50 feet). EIA-232 (RS-232) communication provides transmit, receive, and modem control signals. The LOI port also meets EIA-232D (RS-232D) specifications.

EIA-232 (RS-232) communication has the following communication port designations in ROCLINK 800.

- **LOI** – Local Port EIA-232 (RS-232D). Refer to *Section 5.5, Local Operator Interface*.

- **Built-in** – Comm2 EIA-232 (RS-232C).
- **Module** – Comm3 to Comm5 EIA-232 (RS-232C).

EIA-232 (RS-232) uses point-to-point asynchronous serial communication and is commonly used to provide the physical interface for connecting serial devices, such as gas chromatographs and radios to the ROC800-Series. EIA-232 (RS-232) communication provides essential hand-shaking lines required for radio communication, such as DTR and RTS.

EIA-232 (RS-232) communication includes LED indicators that display the status of the Receive (RX), Transmit (TX), Data Terminal Ready (DTR), and Ready To Send (RTS) control lines.

Table 5-6 defines the built-in EIA-232 (RS-232) terminals at the Comm2 port and their function signals.

Table 5-6. Built-in EIA-232 (RS-232) Signal Routing – Comm2

Signal	LED Function	Terminal
RX	Lit when Comm2 is currently receiving.	1
TX	Lit when Comm2 is currently transmitting.	2
RTS	Lit when Comm2 request to send is active.	3
DTR	Lit when Comm2 data terminal ready is active.	4
GND	Common.	5

The EIA-232 (RS-232) communication module provides EIA-232 (RS-232C) signals on the Comm3, Comm4, or Comm5 port depending on where you have installed the module. Refer to *Table 5-7*.

Table 5-7. EIA-232 (RS-232) Communication Module Signal Routing – Comm3, Comm4, and Comm5

Signal	LED Function	Terminal
RX	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
TX	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	2
RTS	Lit when module (Comm3, Comm4, or Comm5) request to send is active.	3
DTR	Lit when module (Comm3, Comm4, or Comm5) data terminal ready is active.	4
GND	Common.	5

5.8 EIA-422/485 (RS-422/485) Serial Communications Module

EIA-422/485 (RS-422/485) communication modules meet all EIA-422/485 (RS-422/485) specifications for differential, asynchronous serial communication transmissions of data over distances of up to 1220 meters (4000 feet). EIA-485 (RS-485) communication is commonly

used to multi-drop units on a serial network over long distances using inexpensive twisted-pair wiring.

EIA-422 (RS-422) drivers are designed for party-line applications where one driver is connected to, and transmits on, a bus with up to ten receivers. EIA-422 (RS-422) allows long distance point-to-point communication and the drivers are designed for true multi-point applications with up to 32 drivers and 32 receivers on a single bus.

The default values for EIA-422/485 (RS-422/485) communication are 19200 baud rate, 8 data bits, 1 stop bit, and no parity. The maximum rate is 57.6 Kbps.

EIA-422/485 (RS-422/485) communication modules include LED indicators that display the status of receive and transmit activity. Refer to *Tables 5-8* and *5-9*.

Table 5-8. EIA-422 (RS-422) Signal Routing – Comm3, Comm4, and Comm5

Signal	RS-422	Function	Terminal
A	RX +	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
B	RX –	None.	2
Y	TX +	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	3
Z	TX –	None.	4
COM	Common	Ground.	5

Table 5-9. EIA-485 (RS-485) Signal Routing – Comm3, Comm4, and Comm5

Signal	RS-485	Function	Terminal
A	RX / TX +	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.	1
B	RX / TX –	None.	2
Y	No Connect	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.	3
Z	No Connect	None.	4
COM	Common	Ground.	5

⚠ Caution **You can induce ground loops by tying commons from various modules together.**

EIA-422/485 (RS-422/485) communication provides EIA-422/485 (RS-422/485) signals on the Comm3, Comm4, or Comm5 port, depending on where you have installed the module. Wiring should be twisted-pair cable, one pair for transmitting, and one pair for receiving. The EIA-422 (RS-422) module uses four wires and the EIA-485 (RS-485) uses two wires for connectivity.

5.8.1 EIA-422/485 (RS-422/485) Jumpers & Termination Resistors

Four jumpers—J3, J4, J5, and J6—are located on the EIA-422/485 (RS-422/485) communication module (see *Figure 5-5*). These jumpers determine the mode in which the module runs (RS-422 or RS-485) and if the module is terminated.

Terminations are required on the two EIA-422/485 (RS-422/485) communication modules located at the extremities of the circuit. That is to say, the two outside modules require terminations in order to complete the communication circuit.

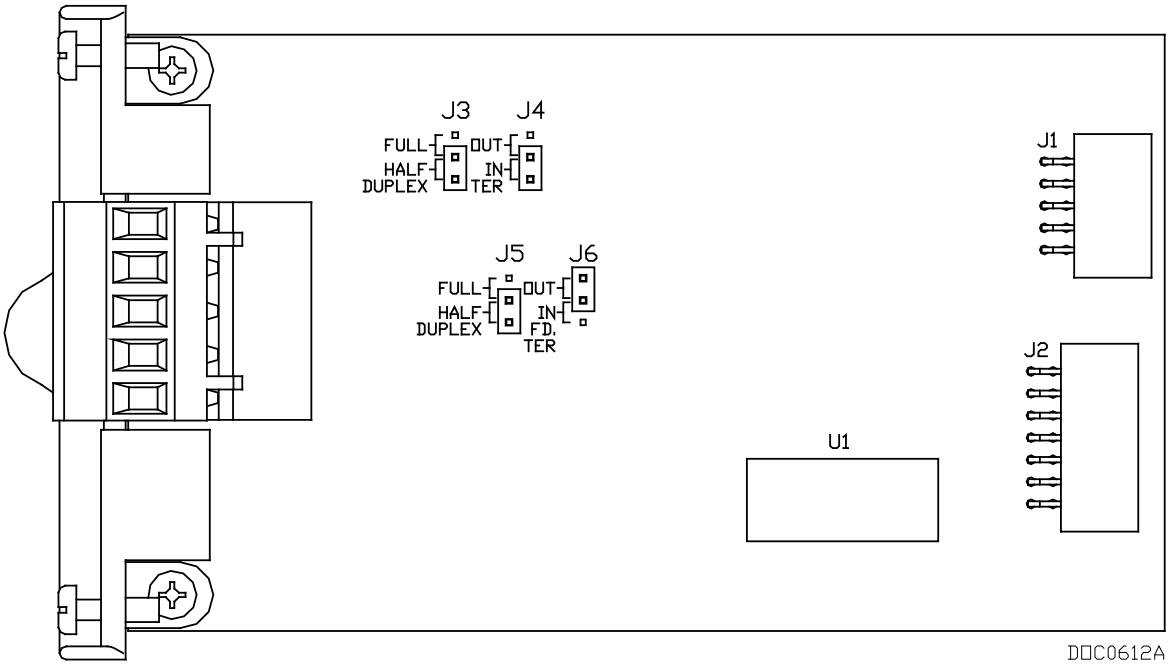


Figure 5-5. EIA-422/485 (RS-422/485) Jumpers

Table 5-10. EIA-422 (RS-422) Module

Jumper	Terminated				Not Terminated			
	TER	Out	Half	Full	TER	Out	Half	Full
J3				x				x
J4	x					x		
J5				x				x
J6	x					x		

Table 5-11. EIA-485 (RS-485) Module

Jumper	Terminated				Not Terminated			
	TER	OUT	Half	Full	TER	OUT	Half	Full
J3			x				x	
J4	x					x		
J5			x				x	
J6		x				x		

5.9 Dial-up Modem Communication Module

The dial-up modem module interfaces to a Public-Switched Telephone Network (PSTN) line, and requires a telephone line connection. The module provides a telephone interface on the host port that is capable of both answering and originating telephone calls. The module also provides electronics that conserve power when the phone line is not in use.

Note: When installing a dial-up modem module, you **must** remove power from the ROC800.

The dial-up modem provides communication with speeds up to 14.4 Kbps with V.42 bis and V.42, MNP2-4 and MNP10 error correction, and is FCC Part 68 approved for use with PSTNs. The FCC label on the module provides the FCC registration number and the ringer equivalent. The module supports data compression, error correction, and nonvolatile RAM for permanent storage of the modem configuration.

Using asynchronous operation, the module interfaces to two-wire, full-duplex telephone lines. It interfaces to a PSTN through an RJ-11 jack.

You control the modem using industry-standard AT command software. A 40-character command line is provided for the AT command set, which is compatible with EIA document TR302.2/88-08006.

The dial-up modem automatically hangs up after a user-configured period of communication inactivity and provides automated dial-up alarm reporting capabilities. Refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series) (*Part Number D301250X012*)* or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

Table 5-12. RJ-11 Field Connections

Signal	Pin
Tip	3
Ring	4

LED indicators on the module show the status of the Receive (RX), Transmit (TX), Ring (RI), and Carrier Detect (CD) control lines.

Table 5-14 displays connector signals and their functions.

Table 5-13. Modem Signal Routing – Comm3, Comm4, and Comm5

Signal	Function
RX	Lit when module (Comm3, Comm4, or Comm5) is currently receiving.
TX	Lit when module (Comm3, Comm4, or Comm5) is currently transmitting.
RI	Lit when module (Comm3, Comm4, or Comm5) detects a ring.
CD	Lit when module (Comm3, Comm4, or Comm5) on carrier detect.

Notes:

- If you are installing a modem module, it is recommended that you install a surge protector between the RJ-11 jack and the outside line.
- The dial-up modem is **not** hot-swappable **or** hot-pluggable. When installing a dial-up modem module, you **must** remove power from the ROC800.

5.10 Multi-Variable Sensor (MVS) Interface Module

The Multi-Variable Sensor (MVS) module provides an interface to a sensor that supplies differential pressure, static pressure, and temperature inputs to the ROC827 for orifice flow calculation.

The enhanced design of the MVS I/O module (shown on the **right** side of *Figure 5-6*) enables you to place it in **any** available slot on the ROC800. In all other ways the two modules are identical.

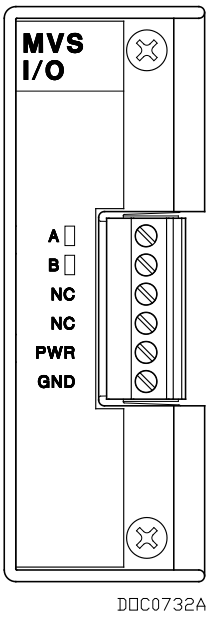


Figure 5-6. MVS I/O Module

For further technical information about the MVS or MVS I/O modules, see the description of the MVS I/O module in *Chapter 4*.

5.11 Network Radio Module (NRM)

The Network Radio Module (NRM) is an integral part of the Distributed RTU Network and allows ROC800-Series (ROC800) to communicate wirelessly. It has the ability to broadcast and detect information from other RTUs for easier and faster interconnection and communication setup.

The NRM provides a wireless solution of transferring data from RTU to another RTU within the Distributed RTU Network (DRN). The data can be any type of information that the RTU has in its database, such as I/O, soft points, or other information.

The NRM includes a FreeWave radio to handle the wireless data transmission. The radio utilizes TDMA technology, and allows for multiple networks (with unique Network IDs and Frequency hop Keys) to be located in close proximity to each other without experiencing signal degradation.

The NRM is designed to be plug-and-play and requires no wiring. The NRM can be installed in slot 1, 2, or 3 in the ROC800-Series 2 RTU.

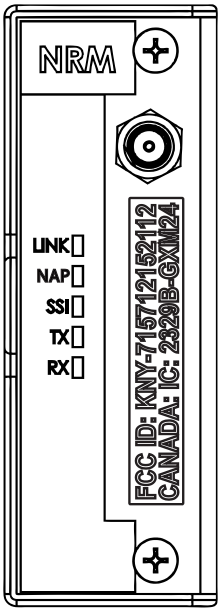


Figure 5-7. Network Radio Module

Depending on the enclosure you choose to surround the node and protect it from the environment, you may need additional cabling between the antenna and the connection on the module itself. For additional details on antenna, cabling, and enclosure installation instructions, refer to the *Distributed RTU™ Network Instruction Manual (*Part Number D301727X012*).*

5.12 Additional Technical Information

Refer to the following technical documentation (available at *www.EmersonProcess.com/Remote*) for additional and most-current information.

Table 5-14. Communication Modules Technical Specifications

Name	Form Number	Part Number
ROC800-Series Communication Modules	ROC800:COM	D301171X012
ROC800-Series Network Radio Module	ROC800:NRM	D301732X012
Distributed RTU™ Network Instruction Manual	A6328	D301727X012

Chapter 6 – Troubleshooting

This chapter provides generalized guidelines for troubleshooting the ROC800-Series. Perform the procedures in this chapter before you remove power from the ROC800 for any reason, after you restore power to the ROC800, and if you disassemble the ROC800.

Use the following tools for troubleshooting:

- Personal computer running a Microsoft® Windows® XP (Service Pack 3), Windows Vista (32-bit), or Windows 7 (32-bit) operating system.
- ROCLINK 800 Configuration software (version 1.81 or greater)
- Flat-head (size 1/10 inch) and Phillips (size 0) screwdrivers.

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6.1 Guidelines

When you are attempting to diagnose a problem with the ROC800:

- Remember to write down what steps you have taken.
- Note the order in which you remove components.
- Note the orientation of the components before you alter or remove them.
- Save the configuration and log data. Refer to *Preserving Configuration and Log Data* in this chapter.
- Read and follow all Cautions in this manual.

When you are done troubleshooting, perform the restart procedure as described in *Restarting the ROC800* in this chapter.

6.2 Checklists

If the LEDs do not display:

- By default, LEDs on the communication modules and I/O modules enter Sleep mode after five minutes.
- To turn the LEDs on, press the LED button located on the CPU for one second.

Note: Using the ROCKLINK 800 software, you can disable this feature so that the LEDs always remain on.

6.2.1 Serial Communications

If you are experiencing troubles with a serial communications connection (LOI, EIA-232, EIA-422, or EIA-485):

- Check to make sure power is applied to the ROC800 unit. Check the position of the J3 jumper on the CPU board (see *Figure 2-8* in *Chapter 2*), the wiring connections at CHG+ and CHG– (for the PM-12 module), and the wiring at the power source.

  Note: On a Series 1 CPU, check the position of the **J4** jumper.

- Check the wiring to the termination block or connector. Refer to *Chapter 5, Communications*.
- Check the communication port settings using ROCLINK 800 Configuration software. Refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

Restore to Factory Defaults

To restore the COM ports to **factory defaults** (as they were delivered to you from the factory) use this procedure:

⚠ Caution **This procedure, valid on the ROC800 (at firmware version 3.1 or higher) and the ROC800L (at firmware version 1.00 or higher) also stops any FSTs, User C programs, and DS800 programs.**

1. Press and hold the RESET button on the powered CPU for 5 to 10 seconds. The Status LED flashes when the process completes.

   Note: Use a small screwdriver or a straightened paper clip to press the RESET button.

2. Release the RESET button.
3. Reconfigure your COM ports.

6.2.2 I/O Point

If you are experiencing troubles with an I/O point (Analog Input, Analog Output, Discrete Input, Discrete Output, Pulse Input, RTD Input, or Thermocouple Input):

- Check (using ROCLINK 800 software) to see how the channel is configured.
- If the configuration looks correct, then follow the procedure for troubleshooting that type of I/O (refer to *Chapter 6*).
- If a module does not function correctly, determine if the problem is with the field device or the module.
- Check a module suspected of being faulty for a short circuit between its input or output terminals. If a terminal not directly connected to ground reads 0 (zero) when measured with an ohmmeter, the module is defective and must be replaced.

Note: Return faulty modules to your local sales representative for repair or replacement.

6.2.3 Software

If you are experiencing problems with the ROC800 that appear to be software-related, try resetting the ROC800.

⚠ Caution **When you reset and subsequently re-start, the ROC800 loses configuration and log data. BEFORE you attempt ANY type of reset, back up your configuration and log data. Refer to *Preserving Configuration and Log Data* in this chapter.**

Warm Start Use a **warm start** to restart without losing configuration or log data. To perform a warm start, open ROCLINK 800 software, connect to the ROC800, and select **ROC** > **Flags**.

Refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

Cold Start Use a **cold start** to restart without a portion of the configuration, log data, or programming that may be the trouble. To perform a cold start, open ROCLINK 800 software, connect to the ROC800, and select **ROC** > **Flags**.

Refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

Restore to Factory Defaults

To restore the ROC800 to **factory defaults** (that is, as the ROC800 was delivered to you from the factory without installed user programs, FLASH memory contents, FSTs, DS800 applications, or configurations) without connecting to ROCLINK 800, use this procedure:

1. Remove power from the ROC800.
2. Press and hold the RESET button on the CPU.

   Note: Use a small screwdriver or a straightened paper clip to press the RESET button.

3. While holding down the RESET button, restore power to the ROC800.
4. Wait 3-5 seconds and release the RESET button.

Note: If none of these methods solves the problem, contact your local sales representative.

6.2.4 Powering Up

If you are experiencing trouble with powering up the ROC800:

- Check the wiring connections at terminations on the Power Input module and the wiring at the power source.
- Check the internal battery for voltage. Refer to *Chapter 3, Power Connections*.
- Check the external batteries, if applicable, for voltage.

Note: If none of these methods solves the problem, contact your local sales representative.

6.2.5 MVS or MVS I/O Module

If you are experiencing trouble with the MVS or MVS I/O module:

- If more than one module is connected to the ROC800, use the ROCKLINK 800 Configuration software to ensure that each module has a unique address.
- Reset the module back to factory defaults. Refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012) or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

Note: If you believe an MVS or MVS I/O module is damaged or faulty, contact your sales representative for repair or replacement.

6.2.6 IEC 62591 Module

If you are experiencing trouble with the IEC 62591 module:

- If the IEC 62591module is already set up, a power cycle of the devices will speed up the discovery of other devices.

6.3 Procedures

Use the following procedures to resolve various issues with the I/O modules.

6.3.1 Preserving Configuration and Log Data

Perform this backup procedure **before** you remove power from the ROC800 for repairs, troubleshooting, or upgrades, This procedure preserves the current ROC800 configuration and log data held in SDRAM.

⚠ Caution

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

To avoid circuit damage when working inside the unit, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Launch ROCLINK 800 software.
2. Select from the ROC menu **Flags** > **Save Configuration**. This saves all configuration settings, including the current states of the ROC800 Flags and calibration values. Click **OK**.
3. Select from the ROC menu > **Collect Data**. Select all check boxes and click **OK**. This saves event logs, alarm logs, report data, hourly logs, and daily logs (you can specify your own file name and path if desired).
4. Select **File** > **Save Configuration**. The Save As dialog box appears.
5. Type the desired file name of the backup file.
6. Select the directory where you desire to store the configuration file.
7. Click **Save**.

6.3.2 Restarting the ROC800

After removing power to the ROC800 and installing components, perform the following steps to start your ROC800 and reconfigure your data.

⚠ Caution

Ensure all input devices, output devices, and processes remain in a safe state upon restoring power. An unsafe state could result in property damage.

When working on units located in a hazardous area (where explosive gases may be present), make sure the area is in a non-hazardous state before performing procedures. Performing these procedures in a hazardous area could result in personal injury or property damage.

Note: The procedure assumes you are using ROCLINK 800 software.

1. Reconnect power to the ROC800.
2. Wait 30 seconds.
3. Launch ROCLINK 800 software, log in, and connect to the ROC800.
4. Verify that the configuration is correct. If major portions or the entire configuration needs to be reloaded, perform the remaining steps.
5. Select **File** > **Download**.
6. Select the backup configuration file (with file extension *.800) from the Open dialog box.
7. Select the portions of the configuration you desire to download (restore).
8. Click **Download** to restore the configuration.
9. Configure other required parameters.

6.3.3 Troubleshooting Analog Input Modules

Before you can determine whether an Analog Input module is operating properly, you must first know its configuration. *Table 6-1* shows typical configuration values for an analog input:

Table 6-1. Analog Input Module Typical Configuration Values

Parameter	Value (AI-12)	Value (AI-16)	Value Read
Adjusted A/D 0 %	819	XXX	1 Volt dc across the + and the COM terminal by a multimeter
Adjusted A/D 100 %	4095	XXXX	5 Volts dc across the + and the COM terminal by a multimeter
Low Reading EU	0.0000	X.XXXX	EU Value with 1 Volt dc
High Reading EU	100.0	XXX.X	EU value with 5 Volts dc
Value	xxxxx	xxxx	Value read by AI module

Equipment Required:

- Multimeter
- PC running ROCLINK 800 software

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

1. Connect a multimeter across the scaling resistor connected to the + and COM terminals of the module and set the multimeter to measure voltage.
2. Connect to ROCLINK 800 software.
3. Select **Configure** > **I/O** > **AI Points**. The Analog Input screen displays.
4. Select the correct Analog Input Point number.
5. Verify the following readings:
   - When the Value is –25% of span as configured in *Table 6-1*, it is an indication of no current flow (0 mA), which can result from open field wiring or a faulty field device. The multimeter should show 0 (zero) Volts dc.
   - When the Value is in excess of 100% of span as configured in *Table 6-1*, it is an indication of maximum current flow, which can result from shorted field wiring or a faulty field device. The multimeter should show over 5 Volts dc.
   - When the Value is between the Low Reading EU and the High Reading EU, verify the accuracy of the reading by measuring the voltage across the terminals with the multimeter.
6. Convert this reading to the Value value:

   $$\text{Value} = [((V_{\text{multimeter}} - 1) \div 4) * \text{Span}] + \text{Low Reading EU}$$

   where Span = High Reading EU – Low Reading EU.

   Note: This calculated value should be within one-tenth of one percent of the Filter value the ROC800 measures.

7. Verify the accuracy by reading the loop current with a multimeter, setting the multimeter to measure current in mA, and connecting it in series with current loop. Be sure to take into account that input values can change rapidly, which can cause a greater error between the measured value and the calculated value.
8. Calculate the Value from the mAmp reading of the multimeter:

   Value = [((mAmpmultimeter* Rscaling resistor – 1) * 4) * Span] + Low Reading EU

   where Span = High Reading EU – Low Reading EU and Rscaling resistor should be 250 ohms (factory installed scaling resistor value).

   Note: If the calculated value and the measured value are the same, the AI module is operating correctly.

9. Remove the test equipment.

6.3.4 Troubleshooting Analog Output Modules

Equipment Required:

- Multimeter.
- PC running ROCLINK 800 software.

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

To calibrate the module:

1. Connect a multimeter between the + and – channel terminals of the module and set the multimeter to measure current in milliamps.
2. Connect to ROCLINK 800 software.
3. Select **Configure** > **I/O** > **AO Points**. The Analog Output screen displays.

   Note: You can also click the graphic image of the module to display this screen.

4. Select the appropriate Analog Outputs Point mumber.
5. Select **Auto** as the Scanning Mode and click **Apply**.
6. Set the Auto Value field to either the value in the **High Reading EU** field or **100** and click **Apply**. The multimeter should read 20 mA.
7. Select the **Advanced** tab on the Analog Output screen.
8. Record the displayed values in the Adjusted D/A 100% and Adjusted D/A 0% fields.
9. Increase or decrease the value in the **Adjusted D/A 100%** field until the multimeter reads 20 mA. (This calibrates the High Reading EU value.) Click **Apply**.

   Note: This step may require some experimentation.

10. Select the **General** tab on the Analog Output screen.
11. Set the Auto Value field to either the value in the **Low Reading EU** field or **0** and click **Apply**. The multimeter should read 4 mA.
12. Select the **Advanced** tab on the Analog Output screen.
13. Increase or decrease the value in the **Adjusted D/A 0%** field until the multimeter reads 4 mA. (This calibrates the Low Reading EU value.) Click **Apply**.

    Note: This step may require some experimentation.

14. Select the **General** tab on the Analog Output screen.
15. Remove the test equipment, and reconnect the field device.
16. If possible, verify the correct operation of the AO module by setting the values in the High Reading EU and Low Reading EU fields to the values you recorded in step 9 and observing the field device.

6.3.5 Troubleshooting Discrete Input Modules

Equipment Required:

- Jumper wire
- PC running ROCLINK 800 software

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

1. Disconnect the field wiring at the DI module terminations.
2. Connect to ROCLINK 800 software.
3. Select **Configure** > **I/O** > **DI Points**. The Discrete Input screen displays.

   Note: You can also click the graphic image of the module to display this screen.

4. Select the appropriate Discrete Input Point number.
5. Place a jumper across a channel input terminal (1-8) and COM. The value in the Status field should change to **On**.
6. Remove the jumper between the channel terminal and COM. The value in the Status field should change to **Off**.
7. Remove the test equipment, and reconnect the field device.

6.3.6 Troubleshooting Discrete Output Modules

Equipment Required:

- Multimeter
- PC running ROCLINK 800 software

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

1. Verify the load current requirement does not exceed the current limit value of the module.
2. Verify that you have correctly wired the module.

3. Remove all wiring from the DO module.
4. Connect the multimeter set up to measure ohms to the channel that you are testing.
5. Measure the resistance with the DO Status OFF. It should be over 2 megohms.
6. Measure the resistance with the DO Status ON. It should be approximately 1 ohm.

6.3.7 Troubleshooting Discrete Output Relay Modules

Equipment Required:

- Multimeter
- PC running ROCLINK 800 software

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

1. Connect the multimeter set up to measure ohms to the channel that you are testing.
2. Set the Status to **On** and click **Apply**.
3. Measure the resistance across the + and **–** terminals. You should have a reading of 0 (zero) ohms with an indication of continuity.
4. Measure the resistance across the + and – terminals. You should have a reading of an open circuit with no continuity indicated.

6.3.8 Troubleshooting Pulse Input Modules

Equipment Required:

- Pulse Generator
- Voltage Generator
- Frequency Counter
- Jumper wire
- PC running ROCLINK 800 software

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

To verify high-speed operation:

1. Disconnect the field wiring at the PI module terminations.
2. Connect to ROCLINK 800 software.

3. Select **Configure** > **I/O** > **PI Points**. The Pulse Input screen displays.
4. Select the correct Pulse Input Point number.
5. Connect a pulse generator having sufficient output to drive the module to terminals L+ or H+ and COM. The pulse generator must synthesize a square wave signal of 50% for every cycle.
6. Connect a frequency counter across terminals L+ or H+ and COM.
7. Set the pulse generator to a value equal to or less than (<=) 10 KHz.
8. Set the frequency counter to count pulses.
9. Verify (using ROCLINK 800 software) that the count read by the counter and the ROC800 are the same.
10. Remove the test equipment, and reconnect the field device.

6.3.9 Troubleshooting RTD Input Modules

The RTD module is similar in operation to an Analog Input module and uses the same troubleshooting and repair procedures.

Equipment Required:

- Multimeter
- PC running ROCLINK 800 software

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

1. Disconnect the field wiring at the RTD module terminations.
2. Connect to the ROCLINK 800 software.
3. Select **Configure** > **I/O** > **RTD Points**. The RTD Input screen displays.
4. Select the correct RTD Input number.
5. If any of the input wires are broken or not connected, the ROCLINK 800 software indicates the Raw A/D Input value is either at minimum (less than 47974) or maximum (greater than or equal to 61958) as follows:
   - An open at the + terminal gives a maximum reading.
   - An open at the – terminal gives a minimum reading.
   - An open at the RET terminal gives a minimum reading.

To verify the operation of the RTD module:

6. Connect to the ROCLINK 800 software.

7. Select **Configure** > **I/O** > **RTD Points**. The RTD Input screen displays.
8. Disconnect the RTD and connect one jumper between the – terminal and RET and another jumper between the + terminal and the REF of the RTD module.
9. Connect either an accurate resistor or decade resistance box with a value to give a low end reading across the + and – terminals.

   Note: Use the temperature-to-resistance conversion chart to determine the resistance value required for the type of RTD being used.

10. Verify that the Raw A/D Input value changed and reflects the Adjusted A/D 0% value.
11. Change the resistance to reflect a high temperature as determined by the temperature-to-resistance conversion chart.
12. Verify that the Raw A/D Input value changed and reflects the Adjusted A/D 100% value.
13. Remove the test equipment, and reconnect the field device.

6.3.10 Troubleshooting Thermocouple Input (T/C) Modules

Note: The TC2 module is **not supported** in the Series 1 ROC800 CPU.

Many digital multimeters can generate and measure thermocouple (T/C) signals. Check the manufacturer's documentation for your multimeter to see if it supports thermocouples and how to correctly use the feature if so equipped. You may require an optional T/C adaptor to use the multimeter.

To test a thermocouple, do not parallel the voltage meter on a thermocouple that is connected to a ROC800, as it will distort the signal.

Do not try to verify a thermocouple that is connected and actively being monitored by a ROC800 by measuring the voltage at the ROC800 terminal blocks.

It is suggested that you independently verify the process temperature, by using a certified thermometer in an adjacent thermowell, and then compare it to what the ROC800 is reading.

Equipment Required:

- Multimeter
- PC running ROCLINK 800 software

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

To test the thermocouple module:

1. Disconnect the thermocouple from the thermocouple module.
2. Generate the correct J or K signal using a multimeter and connect the wiring from the multimeter to the T/C module.
3. Verify the ROC is reading the generated temperature from the multimeter.
4. Remove the test equipment, and reconnect the field device.

To test the thermocouple:

1. Disconnect the thermocouple from the ROC800.
2. Connect the thermocouple directly to the multimeter and verify the reading is correct by comparing it to a certified temperature measurement device connected to the process temperature the T/C is measuring.
3. Remove the test equipment, and reconnect the field device.

Unintentional thermocouple junctions cause many measurement errors. Remember that any junction of two different metals will cause a thermocouple junction. To increase the length of the leads from the thermocouple, use the correct type of thermocouple extension wire. Any connector must be made of the correct thermocouple material and correct polarity must be observed.

If the reading is **off**:

1. The type J or K thermocouples are selected on a per channel basis on the thermocouple module. Verify each channel on the ROC800 and make sure it is set for the type of thermocouple that you are using.
2. Ensure any plugs, sockets, or terminal blocks used to connect the extension wire are made from the same metals as the thermocouples and correct polarity is observed.
3. Verify all connections are tight.
4. Verify the thermocouples have the correct construction (ungrounded) and are not grounded by other means.
5. Verify you are using the correct thermocouple wire all the way from the thermocouple to the ROC800 with minimal connections.
6. Verify the wiring run is adequately protected from noise.
7. Test the thermocouple reading from the thermocouple to a meter, and then generate a signal into the ROC800 as described previously.

8. Finally, connect a thermocouple of the same type directly to the ROC800. If it reads correctly, the problem is likely to be in the wiring to the field or may be related to a ground loop.

6.3.11 Troubleshooting Advanced Pulse Modules

Equipment Required:

- Pulse Generator
- Voltage Generator
- Frequency Counter
- Jumper wire
- PC running ROCLINK 800 software

⚠ Caution **Failure to exercise proper electrostatic discharge precautions, such as wearing a grounded wrist strap may reset the processor or damage electronic components, resulting in interrupted operations.**

To verify high-speed operation:

1. Disconnect the field wiring at the APM module terminations.
2. Connect to ROCLINK 800 software.
3. Select **Configure** > **I/O** > **Advanced Pulse Module**. The Advanced Pulse Module screen displays.
4. Select the correct Pulse Input Point Number.
5. Connect a pulse generator having sufficient output to drive the module to terminals PI1 through PI4 and COM. The pulse generator must synthesize a square wave signal of 50% for every cycle.
6. Connect a frequency counter across terminals PI1 through PI4 and COM.
7. Set the pulse generator to a value equal to, or less than 10 kHz.
8. Set the frequency counter to count pulses.
9. Verify (using ROCLINK 800 software) that the count read by the counter and the ROC800 are the same.
10. Remove the test equipment and reconnect the field device.

6.3.12 Network Radio Modules

To verify connectivity of the Network Radio Module:

1. Check the module status and LEDs if you are already configured and joined to a network.
2. Verify COM status for the commissioned devices by looking at the RL800 RTU commission list.

3. Verify that Access Points have unique settings for the Network ID and Channel.
   - If a duplicate Network ID and Channel exists on the network, a node may indicate connectivity to a Network but will not appear in the Discovery list.
   - A node will not appear on the Access Points Discovery list if there is a second unit setup as an access point.
4. If you are still experiencing trouble with a Network Radio Module, check for any possible physical interference from the environment:
   - Raise antennas above obstructions like trees or compressors. For best communication, the antennas must have line of sight.
   - Mount antennas outside of metal enclosures. Antennas must have at least 10 feet of vertical separation from other antennas.
   - Check for mismatched antennas. Avoid using the incorrect antenna for the frequency of radio. Make sure that the antenna used is for the frequency range of the radio.
   - Check if the cable runs are too long or if the cable is of the wrong type. Less than 3 dB of loss for the entire cable run is recommended. LMR-400 has 3.8dB of loss per 100 feet. The recommended maximum is 75 feet.
   - Waterproof all cable connections. If water gets into the cable, it can cause high VSWR/antenna reflect power.

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Chapter 7 – Calibration

This chapter provides overview information about calibration procedures for the Analog Input (AI) modules, HART module, RTD Input module, and Multi-Variable Sensor modules (MVS and MVS I/O).

For the full calibration procedure, refer Refer to the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012)or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).

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7.2 Calibration Frequency....7-1
7.3 Preparing for Calibration....7-2

⚠ Caution **Before beginning the calibration process, determine if the module is used in a control application. If the module is part of a control application, ensure the system is off-line before proceeding.**

7.1 Calibration Overview

Use ROCLINK 800 Configuration software to perform initial calibration or re-calibration of the inputs on the AI, HART, RTD, and MVS modules. For example, you might re-calibrate after changing an orifice plate in the meter run the ROC800 handles. You can perform calibrations on sensor inputs from either orifice meter runs or turbine meter runs.

The AI, MVS, and RTD calibration routines support five-point calibration, with the three mid-points calibrated in any order. You calibrate the low-end (zero reading) first, followed by the high-end (full-scale) reading. You then calibrate up to three mid-points, if necessary.

The HART calibration routine supports two-point calibration. You calibrate the low-end or zero reading is calibrated first, followed by the high-end or full-scale reading.

7.2 Calibration Frequency

Remote Automation Solutions recommends that your organization establish a routine—quarterly, semi-annual, or annual—pattern of verification and/or calibration for devices and software that meets or exceeds the API 21.1 recommended practices.

Establishing verification and calibration routines ensures not only that your devices and software are functioning optimally but that your

organization is in compliance with appropriate industry and governmental requirements.

7.3 Preparing for Calibration

Before calibrating the inputs from a sensor, HART device, or other device, you should prepare the ROC800.

1. Verify the inputs are correctly wired. For information on wiring the inputs, refer to *Chapter 4, Input/Output Modules*.
2. If you are calibrating a pressure sensor input, be sure to remove the sensor from the flow as directed in the calibration procedure in the *ROCLINK 800 Configuration Software User Manual (for ROC800-Series)* (Part Number D301250X012)or the *ROCLINK 800 Configuration Software User Manual (for ROC800L)* (Part Number D301246X012).
3. Verify that you have connected any external monitoring devices (such as multimeters) to the ROC800, if they are required for the calibration.

Appendix A – Glossary

Note: This is a generalized glossary of terms. Not all the terms may necessarily correspond to the particular device or software described in this manual. For that reason, the term "ROC" is used to identify all varieties of Remote Operations Controllers (including ROC800-Series, ROC800L, DL8000, FloBoss™ 107, and FloBoss™ 100-Series). Refer to *Measurement Units, Symbols, and Abbreviations* (Form A6302) for additional information.

A

A/D	Analog to Digital signal conversion.
ABS	Acrylonitrile Butadiene Styrene.
ADC	Analog to Digital Converter. Used to convert analog inputs (AI) to a format the flow computer can use.
AGA	American Gas Association. A professional organization that oversees the AGA3 (orifice), AGA5 (heating value), AGA7 (turbine), AGA8 (compressibility), and AGA11 (ultrasonic) gas flow calculation standards. See http://www.aga.org.
AWG	American Wire Gauge.
AI	Analog Input.
AO	Analog Output.
Analog	Analog data is represented by a continuous variable, such as an electrical current signal.
AP	Absolute Pressure.
API	American Petroleum Institute. See http://www.api.org.
Area	A user-defined grouping of database entities.
ASCII	American (National) Standard Code for Information Interchange.
Attribute	A parameter that provides information about an aspect of a database point. For example, the alarm attribute is an attribute that uniquely identifies the configured value of an alarm.

B

BMV	Base Multiplier Value, used in AGA7 (turbine) calculations.
BPS	Bits Per Second, associated with baud rate.
BTU	British Thermal Unit, a measure of heat energy.
Built-in I/O	I/O channels that are fabricated into the ROC and do not require a separate option. Also called "on-board" I/O.

C

C1D2	Class 1, Division 2 hazardous area
CMOS	Complementary Metal Oxide Semiconductor, a type of microprocessor used in a ROC.
Coil	Digital output, a bit to be cleared or set.
COL	Ethernet Packet Collision.
COM	Communications port on a personal computer (PC).

C (continued)

COMM	Communications port on a ROC used for host communications. . **Note**: On FloBoss 500-Series and FloBoss 407s, COMM1 is built-in for RS-232 serial communications.
Comm Module	Module that plugs into a ROC to provide a channel for communications via a specified communications protocol, such as EIA-422 (RS-422) or HART.
CF	Compare Flag; stores the Signal Value Discrete (SVD).
Configuration	Refers either to the process of setting up the software for a given system or the result of performing this process. The configuration activity includes editing the database, building schematic displays and reports, and defining user calculations. Typically, the software setup of a device that can often be defined and changed. Can also mean the hardware assembly scheme.
Configuration Tree	In ROCLINK 800, the graphical display that appears when a configuration file opens. It is a hierarchical branching ("tree-style") method for navigating within the configuration screens.
CPU	Central Processing Unit.
CRC	Cyclical Redundancy Check error checking.
Crosstalk	The amount of signal that crosses over between the receive and transmit pairs, and signal attenuation, which is the amount of signal loss encountered on the Ethernet segment.
CSA	Canadian Standards Association. See http://www.csa.ca.
CSMA/CD	Carrier Sense Multiple Access with Collision Detection.
CTS	Clear to Send modem communications signal.

D

D/A	Digital to Analog signal conversion.
DB	Database.
dB	Decibel. A unit for expressing the ratio of the magnitudes of two electric signals on a logarithmic scale.
dBm	Power ratio in decibels (dB), referenced to one milliwatt (mW), also known as dBmW.
DCD	**Data Carrier Detect** modem communications signal. In addition, **Discrete Control Device** – A discrete control device energizes a set of discrete outputs for a given setpoint and matches the desired result against a set of discrete inputs (DI).
DCE	Data Communication Equipment.
Deadband	A value that is an inactive zone above the low limits and below the high limits. The purpose of the deadband is to prevent a value (such as an alarm) from being set and cleared continuously when the input value is oscillating around the specified limit. This also prevents the logs or data storage location from being over-filled with data.
Device Directory	In ROCLINK 800, the graphical display that allows navigation through the PC Comm Ports and ROC Comm Ports setup screen.
DI	Discrete Input.
Discrete	Input or output that is non-continuous, typically representing two levels (such as on/off).
DMM	Digital multimeter.
DO	Discrete Output.
Download	The process of sending data, a file, or a program from a PC to a ROC.
DP	Differential Pressure.
DRN	Distributed RTU Network, in which two or more remotely distributed RTU devices (RRTUs) are wirelessly connected in a peer-to-peer network to share data.

D (continued)

DRTU	A primary component of the Distributed RTU Network, consisting of a FB107 chassis housing a focused functionality CPU and a Network Radio module (NRM). The DRTU collects process variables from one or more wellheads and transmits the signals throughout the designed network.
DSR	Data Set Ready modem communications signal.
DTE	Data Terminal Equipment.
DTR	Data Terminal Ready modem communications signal.
Duty Cycle	Proportion of time during a cycle that a device is activated. A short duty cycle conserves power for I/O channels, radios, and so on.
DVM	Digital voltmeter.
DVS	Dual-Variable Sensor. A device that provides static and differential pressure inputs to a ROC.

E

EDS	Electronic Static Discharge.
EEPROM	Electrically Erasable Programmable Read-Only Memory, a form of permanent memory on a ROC.
EFM	Electronic Flow Metering or Measurement.
EIA-232 (RS-232)	Serial Communications Protocol using three or more signal lines, intended for short distances. Concerning RS232D and RS232C, the letters C or D refer to the physical connector type. D specifies the RJ-11 connector where a C specifies a DB25 type connector.
EIA-422 (RS-422)	Serial Communications Protocol using four signal lines.
EIA-485 (RS-485)	Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion.
EMF	Electro-Motive Force.
EMI	Electro-Magnetic Interference.
ESD	Electro-Static Discharge.
EU	Engineering Units. Units of measure, such as MCF/DAY.

F

FCC	Federal Communications Commission. See http://www.fcc.gov.
Firmware	Internal software that is factory-loaded into a form of ROM. In a ROC, the firmware supplies the software used for gathering input data, converting raw input data values, storing values, and providing control signals.
FlashPAC module	ROM and RAM module for a ROC300-Series unit that contains the operating system, applications firmware, and communications protocol.
Flash ROM	A type of read-only memory that can be electrically re-programmed. It is a form of permanent memory (requires no backup power). Also called Flash memory.
FloBoss	A microprocess-based device that provides flow calculations, remote monitoring, and remote control. A FloBoss is a type of ROC.
FM	Factory Mutual.
Force	Write an ON/OFF, True/False, or 1/0 value to a coil.
FOUNDATION™ Fieldbus	An open architecture for information integration, managed by the Fieldbus Foundation (www.fieldbus.org).
FPV	Compressibility Factor.

F (continued)

FSK	Frequency Shift Keypad.
FST	Function Sequence Table, a type of user-written program in a high-level language designed by Emerson Process Management's Flow Computer Division.
Ft	Foot or feet.

G

GFA	Ground Fault Analysis.
GHz	Gigahertz, 10^9 cycles per second
GND	Electrical ground, such as used by the ROC's power supply.
GP	Gauge Pressure.

H

H1	A Foundation Fieldbus protocol operating at 31.25 kbit/s that interconnects field devices (such as sensors or I/O devices).
HART	Highway Addressable Remote Transducer.
Holding Register	Analog output number value to be read.
HSE Protocol	High Speed Ethernet protocol; a communications protocol operating at 100 Mbit/s used to integrate high-speed controllers (or servers) connected via Ethernet.
Hw	Differential pressure.
Hz	Hertz.

I, J

IC	Integrated Circuit. Also, Industry Canada (more recently known as Measurement Canada), an organization that grants custody transfer approvals on certain ROC units.
ID	Identification.
IEC	Industrial Electrical Code or International Electrotechnical Commission. See http://www.iec.ch.
IEEE	Institute of Electrical and Electronic Engineers. A professional organization that, in conjunction with the International Standards Organization (ISO), establishes and maintains the Open System Interconnection (OSI) reference model and an international standard for the organization of local area networks (LANs). Refer to http://www.ieee.org.
IMV	Integral Multiplier Value, used in AGA3 (orifice) calculations.
Input	Digital input, a bit to be read.
Input Register	Input numeric value to be read.
Local Port	Also LOI; the serial EIA-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.
I/O	Input/Output.
I/O Module	Module that plugs into an I/O slot on a ROC to provide an I/O channel.
IRQ	Interrupt Request. Hardware address oriented.
ISO	International Standards Organization. See http://www.iso.ch.
IV	Integral Value.

K

KB Kilobytes.

kHz KiloHertz.

L

LCD Liquid Crystal Display.

LDP Local Display Panel, a display-only device that plugs into ROC300-Series units (via a parallel interface cable) used to access information stored in the ROC.

LED Light-Emitting Diode.

Logical Number The point number the ROC and ROC Plus protocols use for I/O point types are based on a physical input or output with a terminal location; the point numbers for all other point types are “logical” and are simply numbered in sequence.

LNK Ethernet has linked.

LOI Local Operator Interface (or Local Port). Refers to the serial EAI-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.

LPM Lightning Protection Module; a device that provides lightning and power surge protection for ROCs.

LRC Longitudinal Redundancy Checking error checking.

M

m Meter.

mA Milliamp(s); one thousandth of an ampere.

MAC Address Media Access Control Address; a hardware address that uniquely identifies each node of a network.

Manual mode For a ROC, indicates that the I/O scanning has been disabled.

MAU Medium Attachment Unit.

MCU Master Controller Unit.

Modbus A popular device communications protocol developed by Gould-Modicon.

MPU Micro-Processor Unit.

mm Millimeter.

MMBTU Million British Thermal Units.

msec Millisecond, or 0.001 second.

MVS Multi-Variable Sensor. A device that provides differential pressure, static pressure, and temperature inputs to a ROC for orifice flow calculations.

mV Millivolts, or 0.001 volt.

mW Milliwatts, or 0.001 watt.

N

NAP Network Access Point; the point in the distributed RTU network at which ROCLINK 800

NEC National Electrical Code.

NEMA National Electrical Manufacturer’s Association. See *http://www.nema.org*.

N (continued)

Node A basic structural component of the Distributed RTU Network. A node (usually a FB107 chassis housing a focused-functionality CPU and a Network Radio module) provides a data collection point that wirelessly transmits data throughout the designed network.

NRM Network Radio module; a module used in both the FloBoss 107 and ROC00-Series based devices to wirelessly transmit information throughout the distributed RTU network.

O

OH Off-Hook modem communications signal.

Off-line Accomplished while the target device is not connected (by a communications link). For example, “off-line configuration” refers to configuring an electronic file that is later loaded into a ROC.

Ohms Units of electrical resistance.

On-line Accomplished while connected (by a communications link) to the target device. For example, “on-line configuration” refers to configuring a ROC800-Series unit while connected to it, so that you can view the current parameter values and immediately load new values.

Opcode Type of message protocol the ROC uses to communicate with the configuration software, as well as host computers with ROC driver software.

Operator Interface Also LOI or Local Port; the serial EIA-232 (RS-232) port on the ROC through which local communications are established, typically for configuration software running on a PC.

Orifice meter A meter that records the flow rate of gas through a pipeline. The flow rate is calculated from the pressure differential created by the fluid passing through an orifice of a particular size and other parameters.

P, Q

Parameter A property of a point that typically can be configured or set. For example, the Point Tag ID is a parameter of an Analog Input point. Parameters are normally edited by using configuration software running on a PC.

PC Personal Computer.

Pf Flowing pressure.

P/DP Pressure/Differential Pressure.

PI Pulse Input.

PID Proportional, Integral, and Derivative control feedback action.

PIT Periodic Timer Interrupt.

PLC Programmable Logic Controller.

Point Software-oriented term for an I/O channel or some other function, such as a flow calculation. Points are defined by a collection of parameters.

Point Number The physical location of an I/O point (module slot and channel) as installed in the ROC.

Point Type Defines the database point to be a specific type of point available to the system. The point type determines the basic functions of a point.

Preset Number value previously determined for a register.

PRI Primary PID control loop.

Protocol A set of standards that enables communication or file transfers between two computers. Protocol parameters include baud rate, parity, data bits, stop bit, and the

	type of duplex.
PSTN	Public Switched Telephone Network.
PT	Process Temperature.
PTT	Push-to-Talk signal.
Pulse	Transient variation of a signal whose value is normally constant.
Pulse Interface module	A module that provides line pressure, auxiliary pressure, and pulse counts to a ROC.
PV	Process Variable or Process Value.

R

Rack	A row of slots on a ROC into which I/O modules can be plugged. Racks are given a letter to physically identify the location of an I/O channel (such as “A” for the first rack). Built-in I/O channels are assigned a rack identifier of “A” while diagnostic I/O channels are considered to be in “E” rack.
RAM	Random Access Memory. RAM is used to store history, data, most user programs, and additional configuration data.
RBX	Report-by-exception. RBX always refers to Spontaneous RBX in which the ROC contacts the host to report an alarm condition.
RR	Results Register; stores the Signal Value Analog (SVA).
RFI	Radio Frequency Interference.
RI	Ring Indicator modem communications signal.
ROC	Remote Operations Controller microprocessor-based unit that provides remote monitoring and control.
ROCLINK 800	Microsoft® Windows®-based software used to configure functionality in ROC units.
ROM	Read-only memory. Typically used to store firmware. Flash memory.
Rotary Meter	A positive displacement meter used to measure flow rate, also known as a Roots meter.
RTC	Real-Time Clock.
RTD	Resistance Temperature Detector.
RTS	Ready to Send modem communications signal.
RTU	Remote Terminal Unit.
RTV	Room Temperature Vulcanizing, typically a sealant or caulk such as silicon rubber.
RS-232	Serial Communications Protocol using three or more signal lines, intended for short distances. Also referred to as the EIA-232 standard.
RS-422	Serial Communications Protocol using four signal lines. Also referred to as the EIA-422 standard.
RS-485	Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion. Also referred to as the EIA-485 standard.
RX or RXD	Received Data communications signal.

S

SAMA	Scientific Apparatus Maker’s Association.
SCADA	Supervisory control and data acquisition; referring to a computer system that monitors and controls oil and gas pipeline systems.

S (continued)

Script	An uncompiled text file (such as keystrokes for a macro) that a program interprets in order to perform certain functions. Typically, the end user can easily create or edit scripts to customize the software.
Soft Points	A type of ROC point with generic parameters that can be configured to hold data as desired by the user.
SP	Setpoint, or Static Pressure.
SPI	Slow Pulse Input.
SPK	Speaker.
SRAM	Static Random Access Memory. Stores data as long as power is applied; typically backed up by a lithium battery or supercapacitor.
SRBX	Spontaneous Report-By-Exception. SRBX always refers to Spontaneous RBX in which the ROC contacts the host to report an alarm condition.
SVA	Signal Value Analog. Stored in the Results Register, it is the analog value that is passed between functions in an FST.
SVD	Signal Value Discrete. Stored in the Compare Flag, it is the discrete value that is passed down the sequence of functions in an FST.
System Variables	Configured parameters that describe the ROC; set using ROCLINK software.

T

T/C	Thermocouple Input.
TCP/IP	Transmission Control Protocol/Internet Protocol.
TDI	Time Duration Input.
TDO	Time Duration Output.
Tf	Flowing temperature.
TLP	Type (of point), Logical (or point) number, and Parameter number.
TX or TXD	Transmitted Data communications signal.
Turbine meter	A device used to measure flow rate and other parameters.

U

Upload	Send data, a file, or a program from the ROC to a PC or other host.
USB	Universal Serial Bus, a serial bus standard used to connect devices.

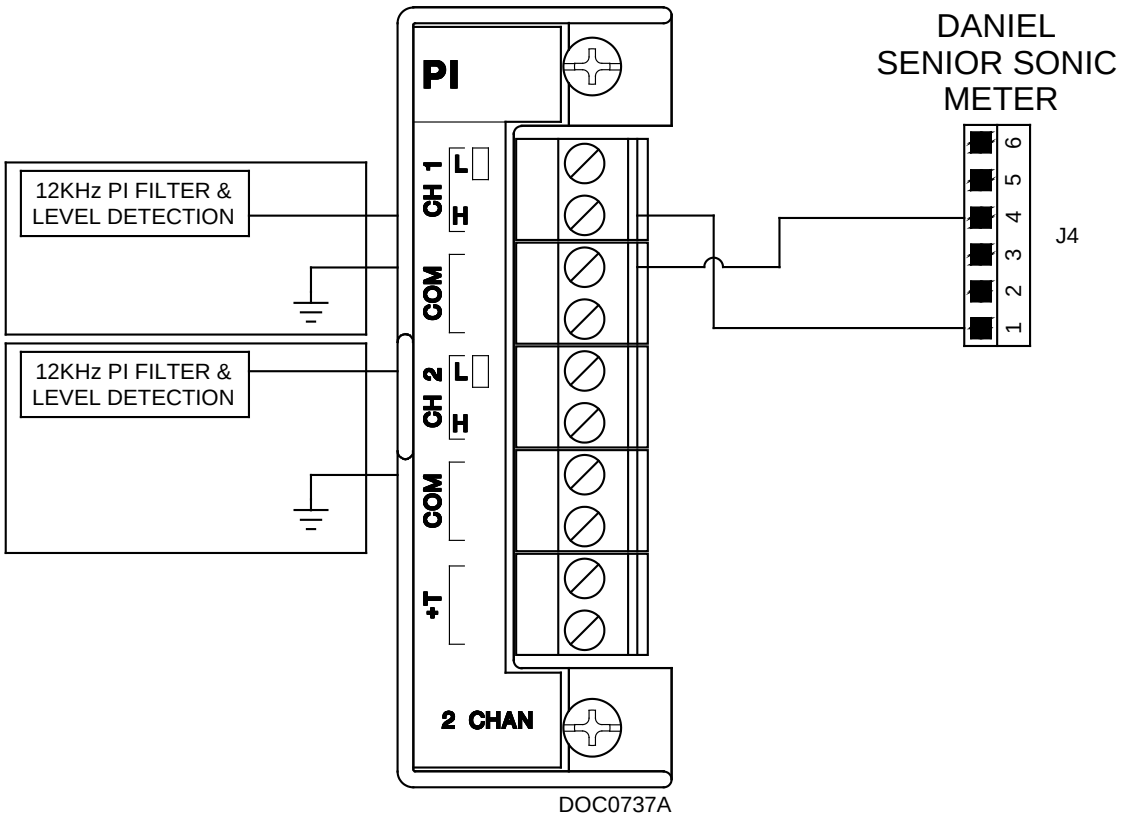
V-Z

V	Volts.

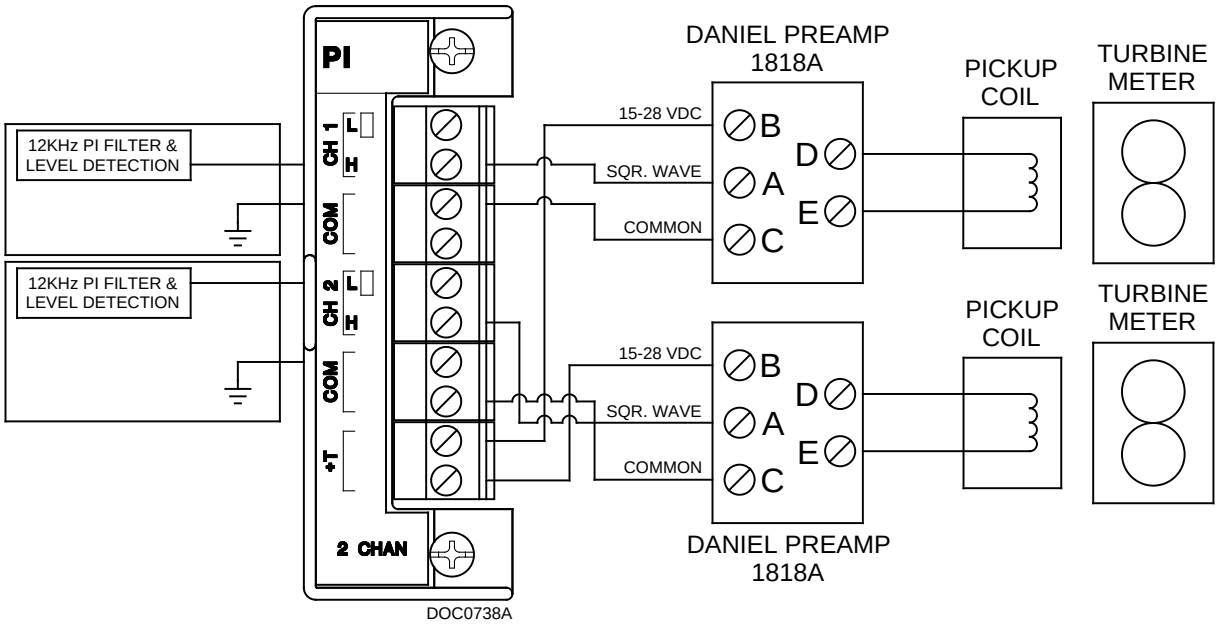
Appendix B – Wiring Diagrams

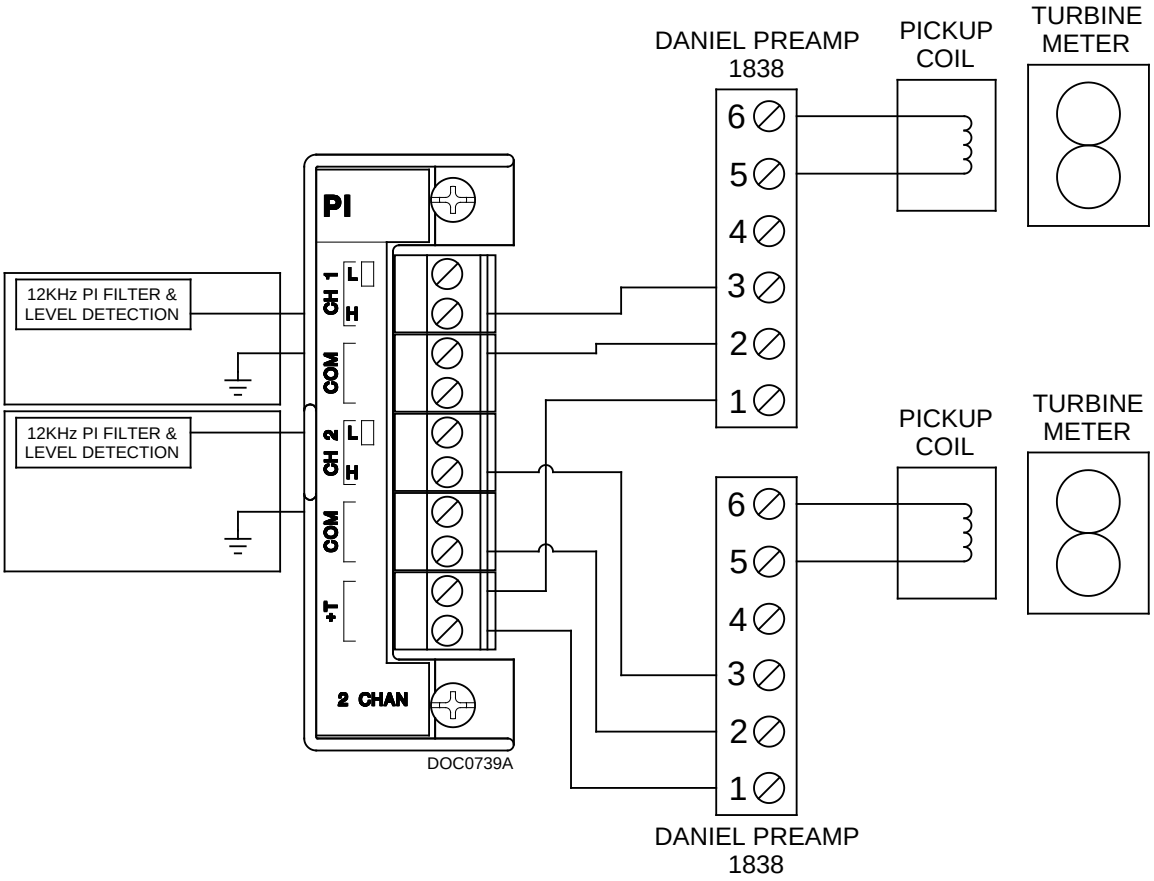
This appendix presents wiring examples for several standard Emerson devices. For other devices, refer to the manufacturer's specifications.

B.1 Daniel Senior Sonic Meter to PI Module

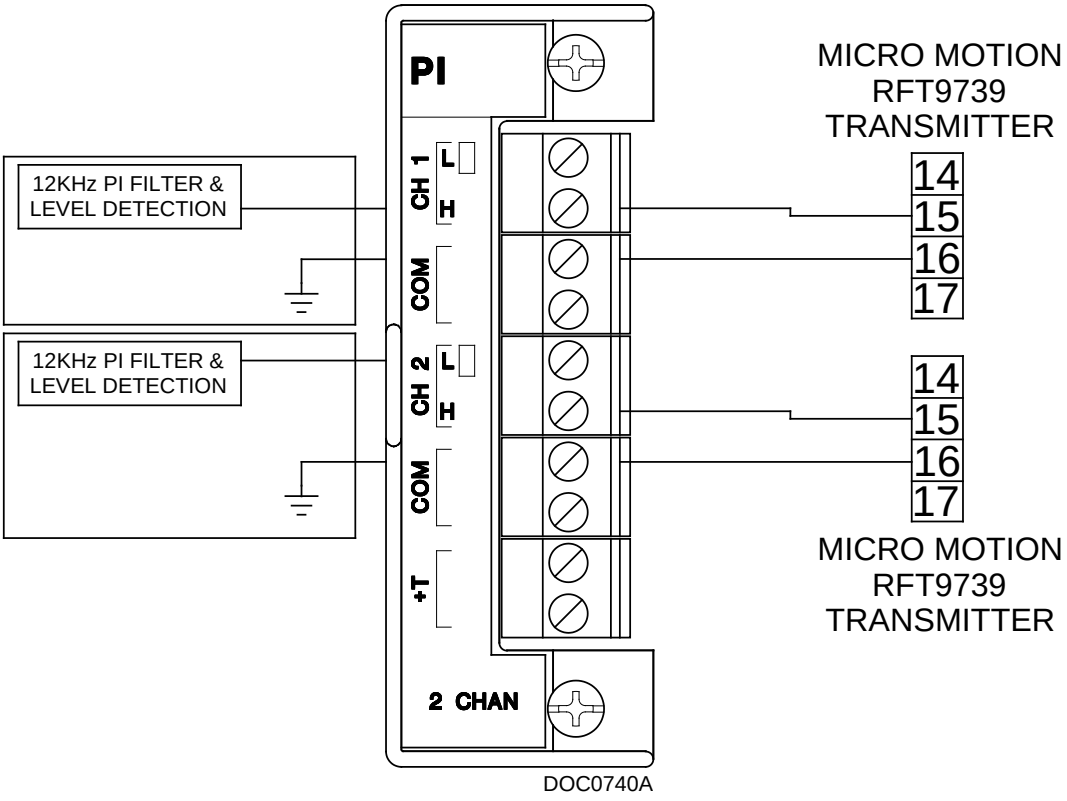


B.2 Daniel 1818A and 1838 Turbine Pre-Amp to PI Module

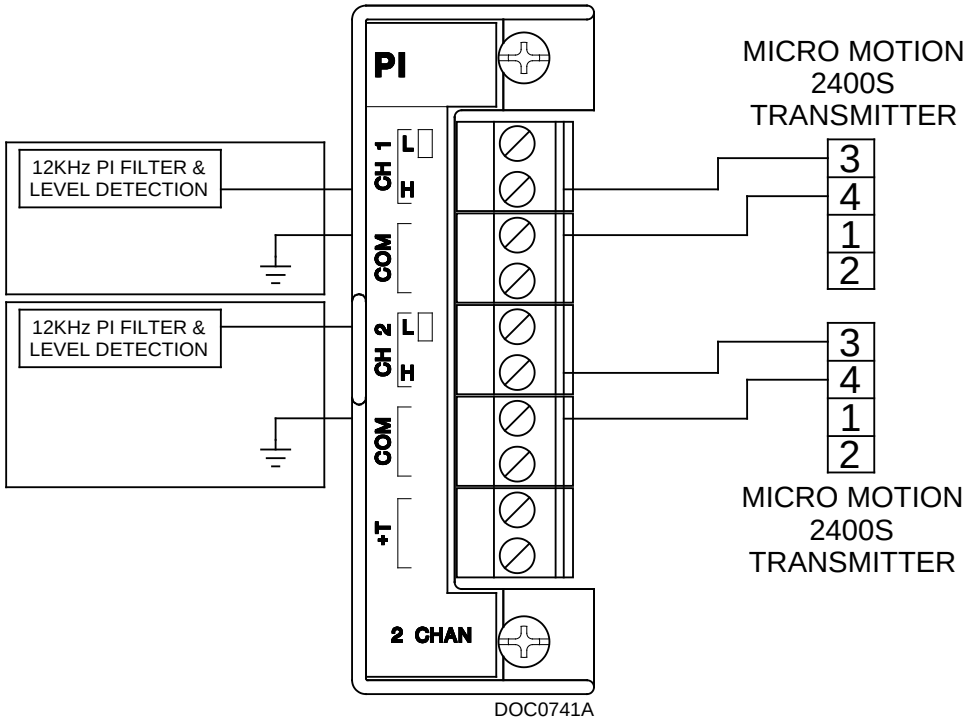




B.3 Micro Motion RFT9739 & 2400S Transmitters to PI Module



DOC0740A



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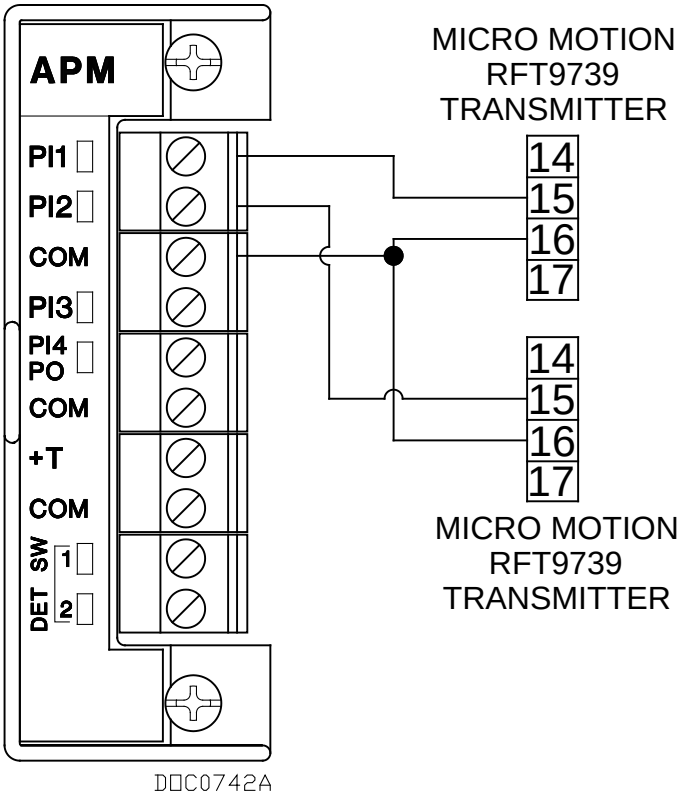
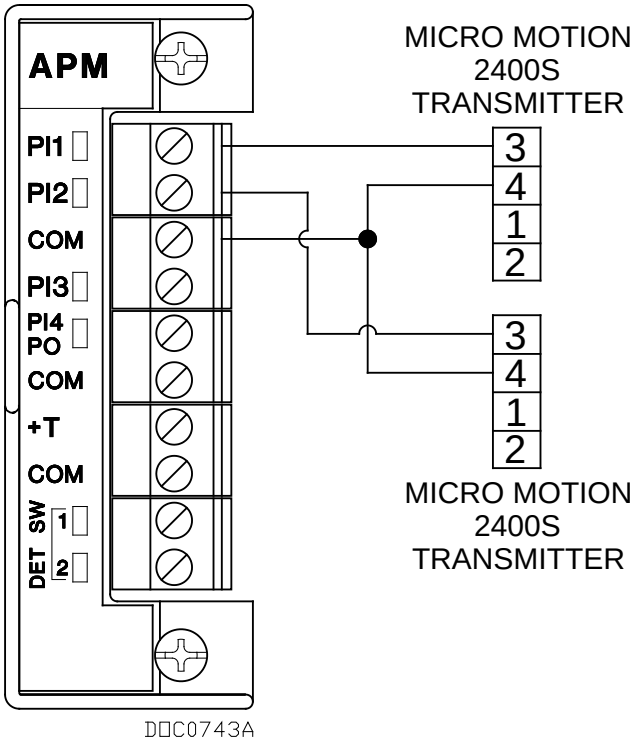
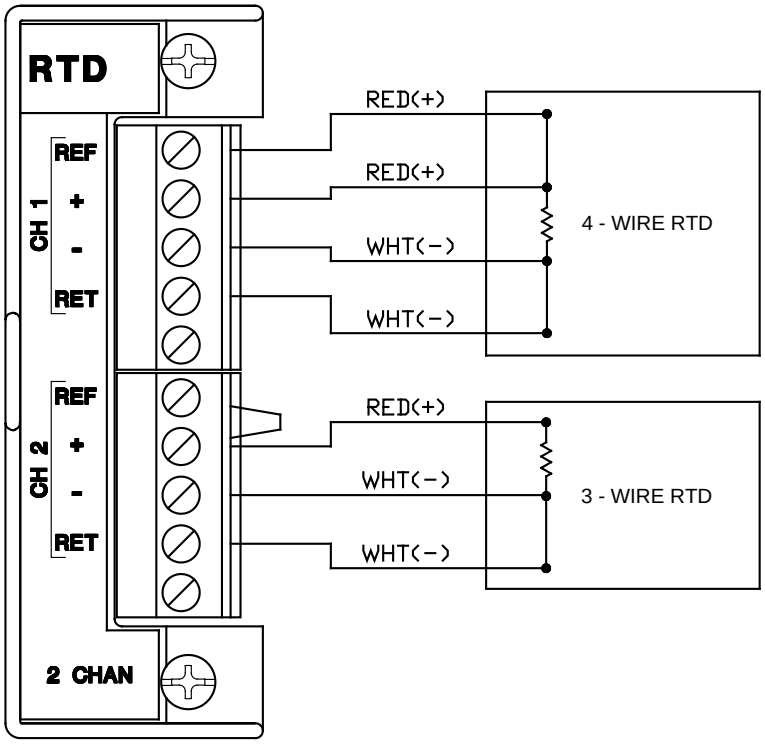
B.4 Micro Motion RFT9739 & 2400S Transmitters to APM Module

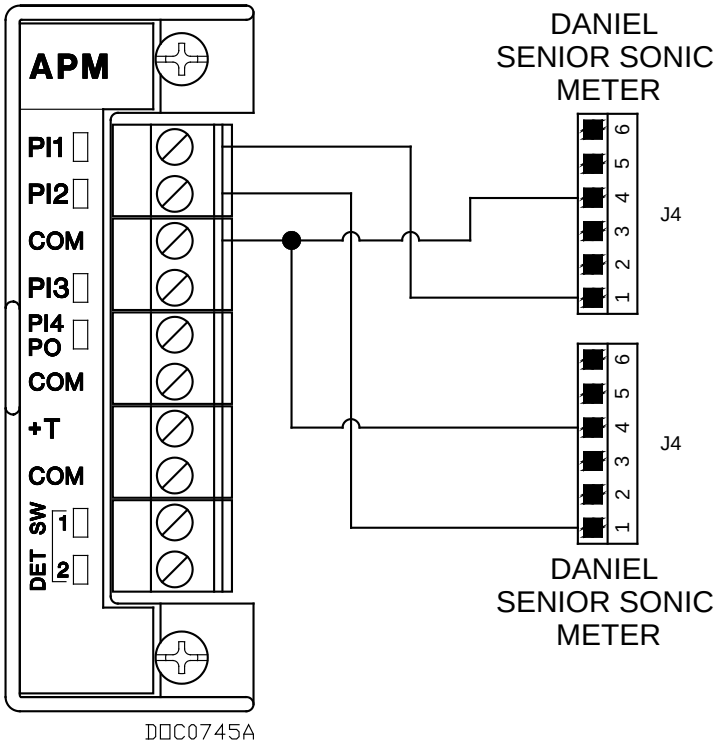




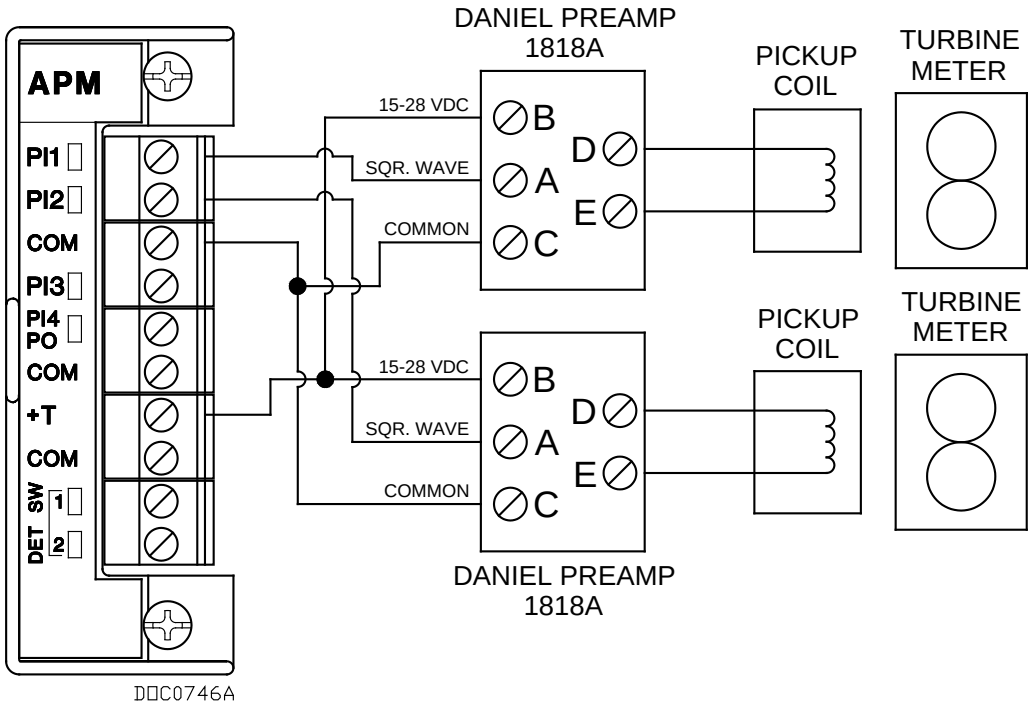
B.5 3- and 4-Wire RTD to RTD Module

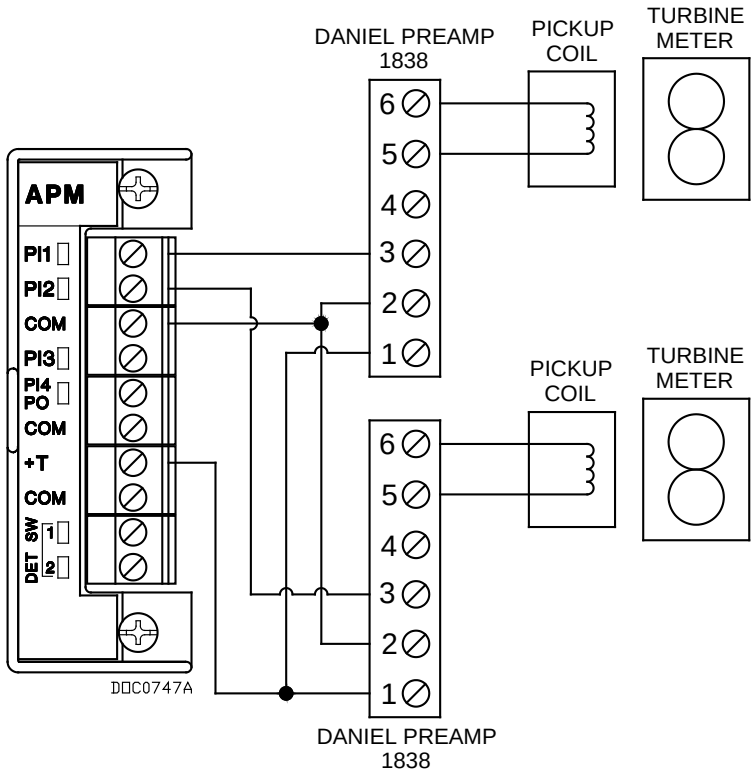


B.6 Daniel Senior Sonic Meter to APM Module

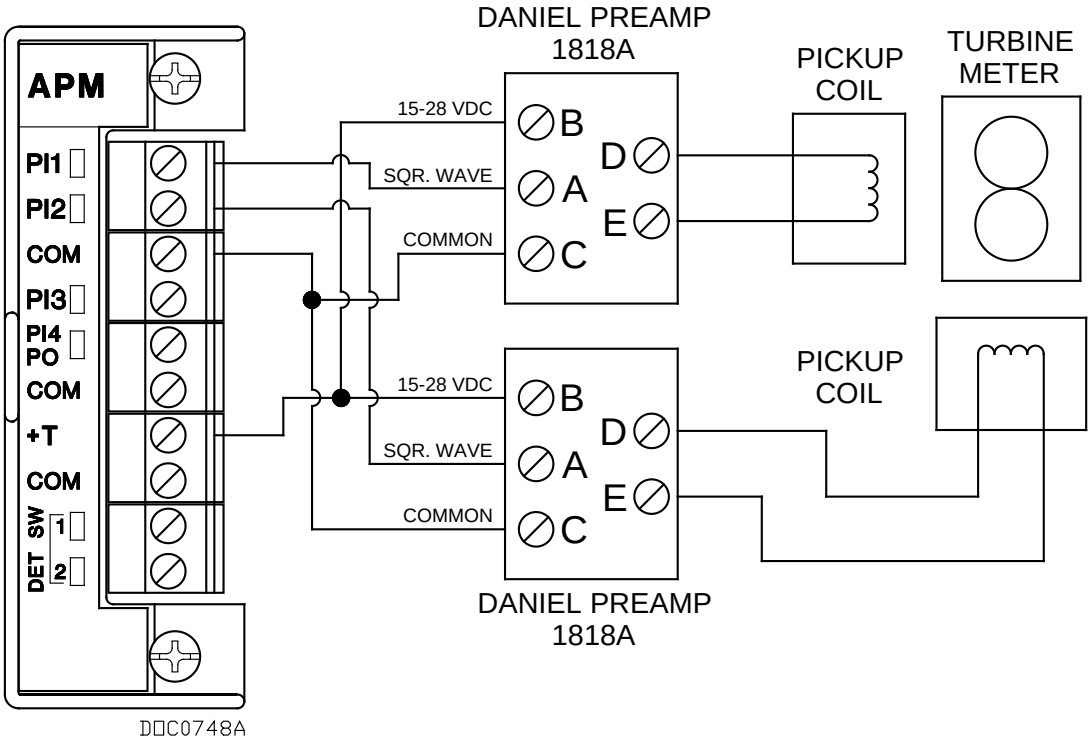


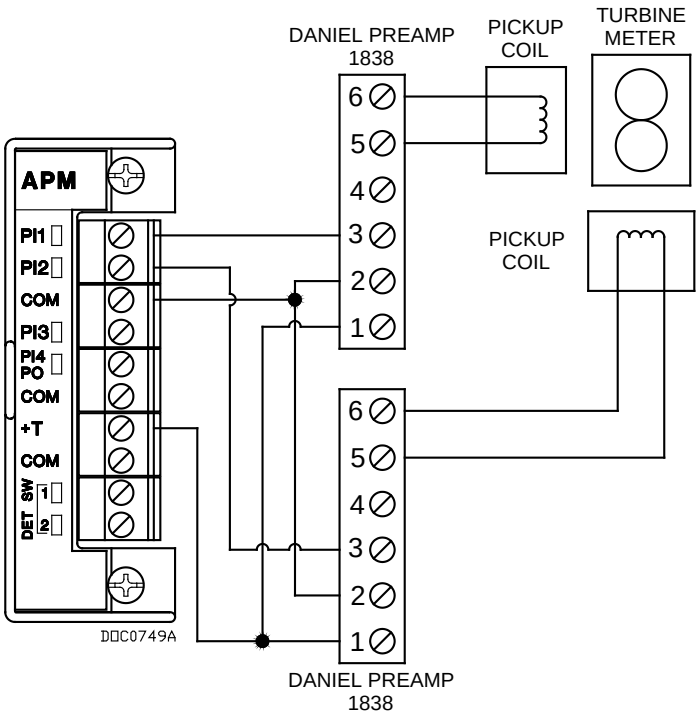
B.7 Daniel 1818A and 1838 Dual Turbine Pre-Amp to APM Module



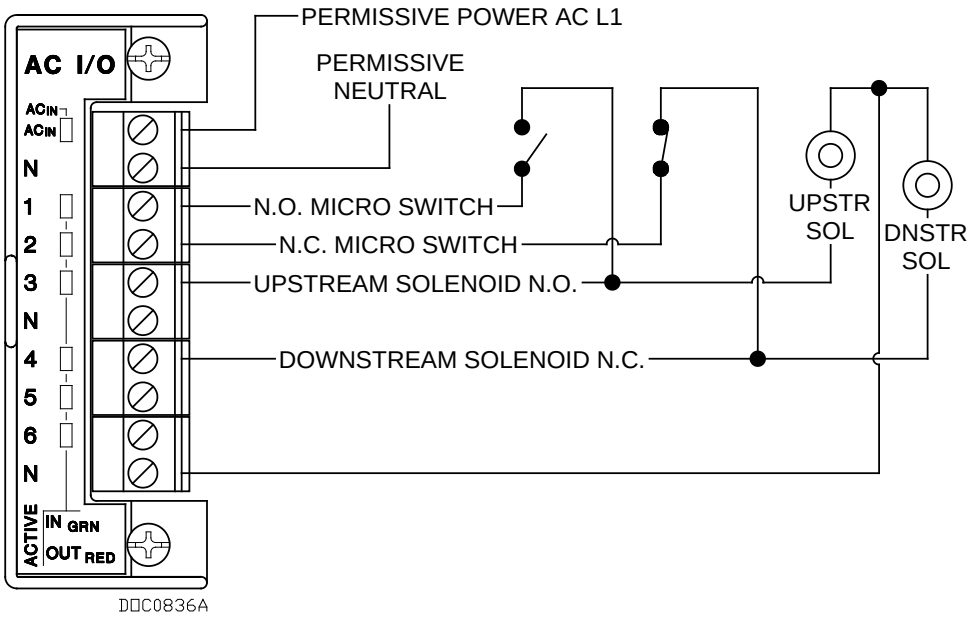


B.8 Daniel 1818A and 1838 Turbine Pre-Amp to APM Module





B.9 Two-Stage Valve with Two Limit Switches to ACIO Module



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